US Army Corps
of Engineers
Tulsa District

PINE BLUFF ARSENAL

SITE 20A
DEPOT SOUTH BURNING PIT

SITE CLOSURE PLAN

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DEPARTMENT OF THE ARMY
TULSA DISTRICT, CORPS OF ENGINEERS
OKLAHOMA

PINE BLUFF ARSENAL
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TABLE OF CONTENTS

TABLE OF CONTENTS (CONT)

FIGURE INDEX

TABLE INDEX

EXHIBIT INDEX

APPENDIX INDEX

TABLE OF CONTENTS (CONT)

DRAWING INDEX

SYNOPSIS

Site 20A, the Depot South Burning Pit at Pine Bluff Arsenal, Arkansas, will be closed in a FY 86 Military Construction, Army (MCA) project in accordance with all applicable State and Federal regulations. The general investigative procedures followed at Site 20A were to establish the extent and nature of contamination of waste materials both on the surface and in the underlying soils. This included investigations sufficient in scope to determine the vertical and horizontal limits of contaminants present and also to determine if the contaminants would classify as hazardous waste. This contamination is associated with residue from past burning of pyrotechnic mixes and other incendiary devices. Neither the surface waste or subsurface materials at Site 20A classify as hazardous waste when subjected to tests for EP toxicity. Additional investigations were made to determine the most effective means of encapsulation that would satisfy the requirements for final disposal of waste materials at the site. The subsurface investigations show that an impermeable clay layer underlies a portion of the site and is a suitable lower boundary for an in situ encapsulation of the waste materials. The clay zone has demonstrated its effectiveness as an impermeable boundary by restricting movements of any contaminants during the past 40 years. An integral part of the closure plan would include vertical impervious trenches keyed into the clay layer at the boundaries of the encapsulation site with a clay cover for positive control of contaminants. This closure plan is considered to be the most economical and environmentally acceptable alternative, based on the data presented in the following narrative.

I - GENERAL

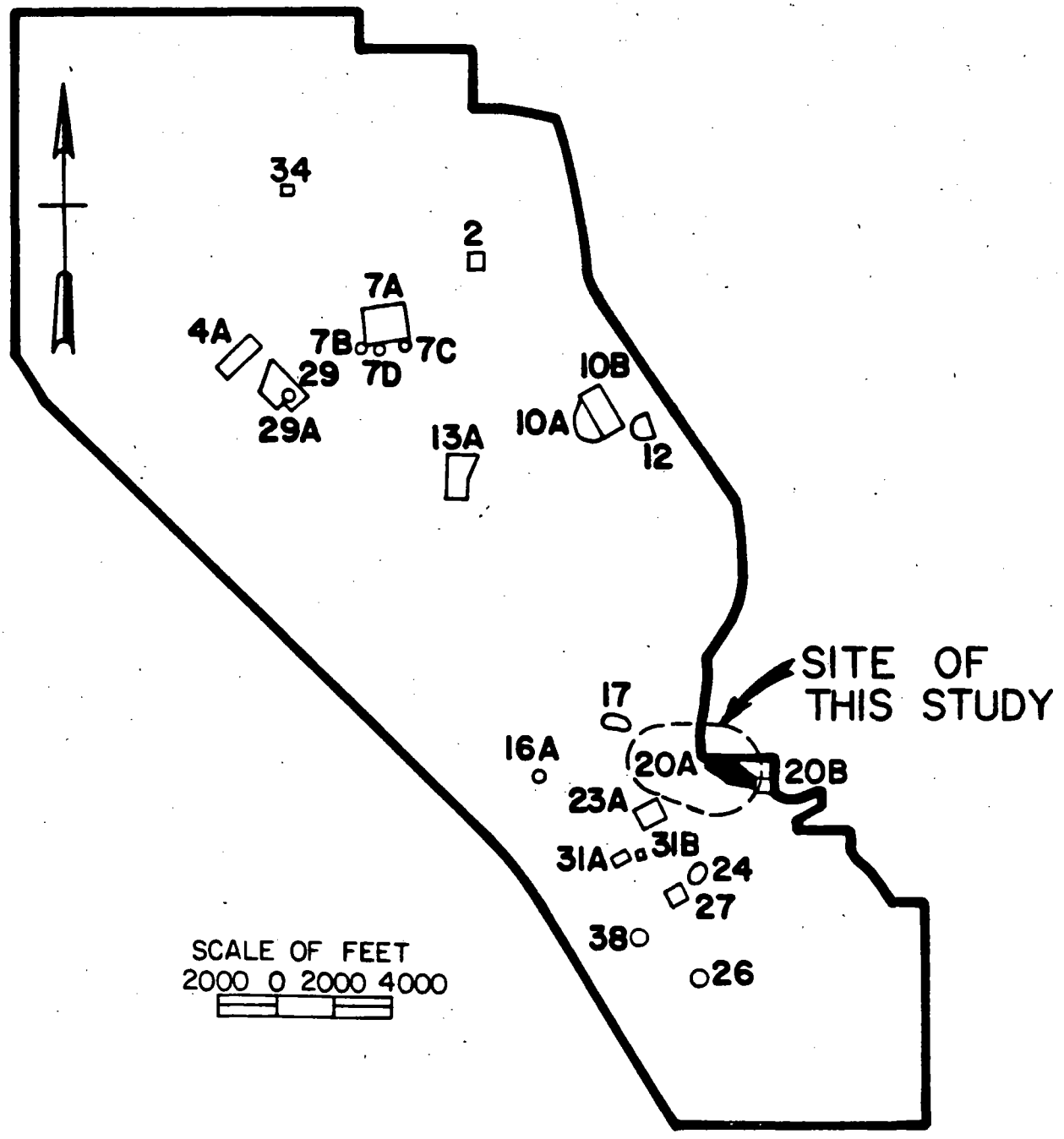
1-01. Purpose. This report presents the closure plan for contaminated waste materials located at Site 20A, the Depot South Burning Pit at Pine Bluff Arsenal, Arkansas. This site is an inactive site and will be permanently closed in accordance with applicable State and Federal regulations. Closure of this site is required to eliminate an historical open dump and prevent contamination of the waters of the State of Arkansas. Discussions between Arkansas Department of Pollution Control and Ecology (ADPCE) and Pine Bluff Arsenal (PBA) personnel determined that the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) procedures would be applicable to closure of the site provided that contaminants in the soil and burned fill did not classify as hazardous as defined by the Resource Conservation and Recovery Act (RCRA).

1-02. Report format. A site description is presented in Section 2. The geotechnical investigations which form the bases for the proposed closure plan are contained in Section 3. A description of the encapsulation scheme proposed for closure of this site is presented in Section 4. The indicated closure plan is considered to be the most cost effective and environmentally acceptable alternative based on the results of geotechnical investigations and existing site conditions. Other alternative closure plans studied and a cost comparison of all plans are presented in Sections 5 and 6, respectively.

II - SITE DESCRIPTION

2-01. General. Site 20A will be closed in the FY 86 MCA project, "Hazardous Landfill/Closure Sites. Extensive subsurface information, as described in Section 3, was obtained at the site to develop the most suitable closure plan. The residue from the burning operations is contaminated with lead, zinc, and barium. Because of the large volume of this burned material an in situ closure scheme is desirable. Approximately 53,000 cubic yards of burned fill and 5,000 cubic yards of contaminated soil, for a total of 58,000 cubic yards of contaminated material, are present at Site 20A. Information from previous studies indicated the possible presence of a natural clay strata that could serve as an impermeable lower boundary in an encapsulation scheme.

2-02. Site description. Site 20A, the Depot South Burning Pit, is located within the Arkansas River flood plain adjacent to a swampy wetland (see figure 2-1). The site consists of a 5-acre burning pit and adjacent storage area along the eastern boundary of the arsenal, north of the Pollution Abatement Facilities, as shown on the aerial photograph in figure 2-2. The majority of the site is flat, at approximate elevation 212.0, sloping gently to the northeast toward a lagoon area. The water in the lagoon remains at elevation 202.0 for most of the year. Vegetation grows, with no apparent distress, on the western part of the site. The eastern part of the site is covered by a pavement-like residue upon which no vegetation grows. From 1941 to 1978 pyrotechnic mixes from smokes, grenades, and other incendiary devices were burned at the site, resulting in a layer of burned fill and rubble greater than 12 feet thick in places. Various wastes including smoke mixes, munitions, WP contaminated materials, solvents, and DS-2 decon fluid were stored on the burned fill and the area adjacent to it. All accumulated containerized materials and surface debris dumped on the site are now being hauled to an approved off-site hazardous waste landfill as part of an emergency service contract. This work will be completed in February, 1984.



SITE LOCATION MAP

FIGURE 2-1

SITE 20A

AERIAL VIEW

FIGURE 2-2

SCALE: 1" = 400'

III - GEOTECHNICAL INVESTIGATIONS

3-01. Introduction. The purpose of the exploration program was to (1) determine the location and properties of any clay strata beneath the site that would be acceptable for use as a lower impermeable boundary in an in site encapsulation scheme and (2) refine the type, severity, and lateral and vertical extent of contamination.

3-02. Field investigations.

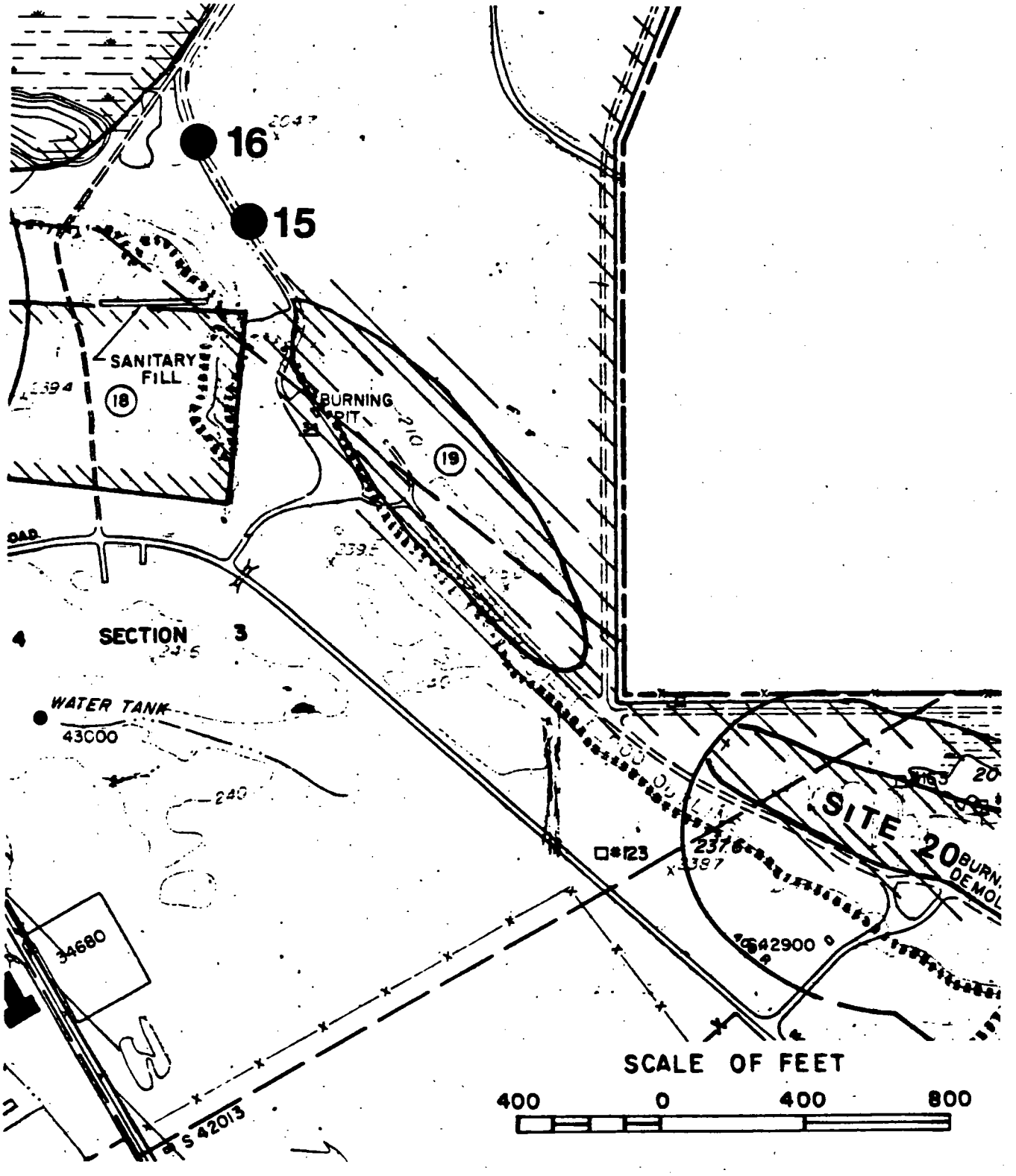
a. Preliminary. Prior to beginning the current investigations at Site 20A, some chemical, soil, and groundwater data was available. Ninety shallow borings, about 20 feet deep, were drilled at the site for the 1973 - 1975 Contaminated Area Survey Project. The soil, though not classified or described, was tested for some of the heavy metals, pH, and other possible contaminants. In 1981, 3 upgradient and 4 downgradient monitoring wells were installed at Site 20A. Material from these wells was field classified. These wells are sampled by PBA and assayed regularly by the Army Environmental Hygiene Agency (AEHA) for selected contaminants. The downgradient wells are located as shown on drawing 1.

b. Auger sampling.

(1) Twenty-three auger holes, mostly 40 feet deep, were drilled in the Arkansas River flood plain at the site in the fall of 1983. Locations of these borings are shown on drawing 1. Three hand auger holes were drilled on the northeast side of the lagoon. Two holes (holes 15 and 16) were drilled northwest of the site within the floodplain to establish background heavy metal concentrations. These hole locations are shown on figure 3-1. Soil from the auger holes was described in the field, classified in the laboratory, and tested for the toxic heavy metal contaminants as defined by RCRA, these being arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver. In addition, total phosphate and zinc were determined because of their suspected presence at the site, although neither are RCRA toxic contaminants. Zinc was found in high concentrations during the 1973-75 Contaminated Area Survey Project. Zinc, in the form of zinc oxide, is a major constituent of smoke mixes disposed of at the site. Because some white phosphorous contaminated materials were stored at the site, total phosphate was determined in some of the borings as well.

(2) Each run with the auger was limited to 3 feet. To prevent mixing of materials or sampling material that had pulled off from the wall of the hole, only the interior portion of each sample was used. Material was taken from the entire 3-foot sample and put into a glass jar and shipped daily by bus to the Corps of Engineers, Southwestern Division Laboratory in Dallas. Groundwater was sampled in some of the holes and analyzed for heavy metals. If the hole penetrated a clay layer, it was backfilled with grout.

c. Undisturbed sampling. One denison sample of clay was obtained from a boring offset slightly from hole 4 from a depth of 15.5 to 17 feet. The sample was obtained for a laboratory permeability test and is representative of the natural clay stratum beneath the site.



BACKGROUND HOLES

FIGURE 3-1

d. Lagoon traverses. Three traverses were made across the lagoon by boat from the southwest shore to the tree line located in the middle of the lagoon. Sediment samples were taken at 10-foot intervals by a Ponar dredge along the first and third traverses, and by a ball check core sampler on 5-foot intervals along the second traverse. The samplers took an 18-inch core from which an upper sample was taken at the water/sediment interface and a lower sample was taken from the deepest material retained in the sampler. A total of 41 upper and 24 lower samples were taken. The lagoon traverses are shown on drawing 2.

e. Grab sampling. To supplement the auger and lagoon sampling water, soil, and sediment samples were taken along both sides of the lagoon. Three water samples were taken from the lagoon, eleven sediment samples were taken from both sides of the lagoon near the shore, and 2 soil samples were taken from the back side of the lagoon. These sampling locations are also shown on drawing 2.

f. Burned fill study. In order to determine the thickness and extent of the burned fill, 135 shallow holes were made with a drilling hand auger, posthole digger, or shovel.

3-03. Laboratory testing.

a. Chemical testing procedures. Soil samples were digested in a strong acid and the resulting extracts were tested by atomic absorption spectroscopy techniques. With the exception of the EP toxicity tests, the acid treatment resulted in total ion extraction, freeing the metals from the soil and the pore water. A representative portion of the sample was oven dried and the values reported in milligrams/kilogram (mg/kg) dry weight. Groundwater and lagoon water samples were filtered in the lab and given a similar acid treatment. These results are reported in milligrams/liter (mg/l). In the EP toxicity test, the soil material was treated with a weak acid to simulate natural leaching conditions, then agitated. The resulting extract was tested for ion content with the results reported in mg/l. Laboratory procedures are described in greater detail in Appendix I.

b. Physical soil testing. Atterberg limits, sieve analyses, and natural water content tests were performed on selected soil samples by the Corps of Engineers Southwestern Division Laboratory. The resulting classifications, based on the Unified Soil Classification System, are used to identify material types shown in the geologic sections presented in drawings 4 through 6. Laboratory visual classifications were also used to verify field classifications. One falling head permeability test was conducted on an undisturbed sample from a depth of 16 ft in hole 4.

3-04. Analysis.

a. Background levels of contaminants. In order to define contamination, a determination of the background concentration of contaminants was made. Concentrations of contaminants in samples from borings in the contaminated area were compared with the background concentrations, and the limits of contamination were established. A determination of the natural (background) concentrations of the chemicals in

the soil at Site 20A was made by drilling two background holes in a geologically similar area that was as close as possible to the site but free of the effects of contamination from the site. As previously mentioned, the locations of the two background holes (15 and 16) with respect to Site 20A are shown on figure 3-1. Two different material types were encountered, clay and silt, and each type was found to have different background chemistry. Eight of the soil samples tested were clay and two were silt. Mean concentrations for each chemical in clay and mean concentrations for each chemical in silt were calculated. A sample standard deviation was calculated for each chemical in clay. If data is normally distributed, and a value is chosen two standard deviations around the mean, then approximately 95 percent of the data will be within these values. If a measured value exceeds these 95 percent confidence intervals, it is probable that the measured value is not within the normal range of background values for that chemical. In the silt, a standard deviation was not calculated because there were only two values for each chemical. In the clay, two standard deviations averaged to be 86 percent of the mean value, so the upper limit of the 95 percent confidence interval in the silt was also taken to be the mean plus 86 percent of the mean. These 95 percent confidence intervals for clay and silt are tabulated in table 3-1.

The upper limit of the 95 percent confidence interval is plotted in Appendix II for each chemical tested in each auger hole. The value for the material type encountered (i.e. clay or silt) is plotted at the appropriate depth. Several of the borings were drilled to obtain stratigraphic information and were not tested for chemistry.

TABLE 3-1

BACKGROUND SOIL CHEMISTRY
(All values in mg/kg)

	CLAY		SILT	
Contaminant	Background Mean	Upper Limit of 95% Confidence Interval (1)	Background Mean	Upper Limit of 95% Confidence Interval (1)
Arsenic (As)	7.1	13.9	1.9	3.6
Barium (Ba)	78.6	150.4	41.6	77.4
Cadmium (Cd)	<0.5	-	<0.5	-
Chromium (Cr)	<5.0	-	<5.0	-
Lead (Pb)	13.5	21.1	5.2	9.6
Mercury (Hg)	<0.1	-	<0.1	-
Selenium (Se)	<0.1	-	<0.1	-
Silver (Ag)	<0.5	-	<0.5	-
Zinc (Zn)	44.5	80.3	21.7	40.4
Total Phosphate (TPO_4)	368.1	771.3	249.5	464.1

(1) An upper limit of the 95% confidence interval was not calculated for the chemicals which were below minimum reported values in the background holes.

b. Depth of contamination determination.

(1) Method. The depth of contamination at Site 20A was determined by comparing measured concentrations of contaminants with background levels (as discussed above). Sample test results are plotted with depth on the same figure as the background levels (Appendix II) so a comparison could readily be made. Once the results are plotted in this manner the depth of contamination is readily determined.

(2) Procedures for determining laboratory tests. Samples from holes 3 and 4, both located in the burned fill area, were tested for lead,

zinc, barium, arsenic, chromium, cadmium, selenium, silver, mercury, and total phosphate. The background holes (15 and 16) were also tested for these chemicals. Based on the results, lead was found to be the contaminant which best indicated the limits and degree of contamination at the site and was selected for testing in future borings. Zinc was found to be present in concentrations above background levels and was found to be more mobile than the eight RCRA toxic heavy metal contaminants. Although the limits of significant zinc were established they are not indicative of the limits of any of the toxic contaminants. Holes 1 through 5 were tested to total depth for lead, but in most of the holes only the upper portion (about 10 to 20 feet) was tested. Once it was determined that the burned fill was heavily contaminated with lead, after consistent results from about half a dozen selected holes, the fill was not tested further. Barium, which was found in low concentrations in the groundwater monitoring wells, was determined in samples from several holes. Total phosphate was tested for in holes 4 and 5 which were located near a storage area for white phosphorus contaminated materials. Lagoon and soil grab samples were also selectively tested in an effort to determine the depth and extent of contamination. Jar samples not tested, as well as the remainder of samples which were tested and the leftover acid digests, are being retained by the laboratory. Results of laboratory chemical tests are given in Appendix I. EP toxicity tests were performed on four of the most highly contaminated samples from Site 20A. Two samples of burned fill material, one sample of clay beneath the burned fill, and one lagoon sediment sample were tested. Test results are presented in table 3-2. None of the test results exceeded the limits for EP toxicity set forth in RCRA.

TABLE 3-2

EP TOXICITY RESULTS
(Values in mg/l)

Sample #	Depth (ft)	As	Ba	Cd	Cr	Pb	Hg	Se	Ag
(RCRA limit)	-	5.0	100.0	1.0	5.0	5.0	0.2	1.0	5.0
20A-3 Jar 3	3.0-6.0	0.00075	3.2	0.01	0.01	0.045	0.0002	0.0018	0.01
20A-4 Jar 3	6.5-9.5	0.00075	3.55	0.11	0.01	0.170	0.0001	0.020	0.01
20A-4 Jar 4	9.5-12.5		0.2			0.04			
SD-2 (lagoon sediment)	surface	0.00175	3.55	0.015	0.01	0.01	0.0002	0.019	0.01

c. Contamination results.

(1) Burned fill contamination. The burned fill is highly contaminated with lead in every sample tested, both on the ground surface and beneath the lagoon, with lead concentrations as high at 2700 mg/kg. High concentrations of zinc are also present in the burned fill. Lesser amounts of barium, arsenic, chronmium, and total phosphate also occur in the fill. Drawing 3 shows the limits and thickness of the burned fill material.

(2) Soil contamination. Sections A-A through D-D, on drawings 4 through 6, show maximum depth of significant lead and zinc. The overwhelming majority of the contamination is confined to the burned fill material. Lead occurs in significant quantities in the soil in hole 25. This soil, which is described as a gray, organic-appearing sandy clay, has 380 mg/kg lead and is contaminated for a depth of 3 feet below the fill. Hole 20 has some lead in the upper 3 feet below the fill, about 16 mg/kg. Lead does not occur in significant quantities in any holes drilled outside the burned fill area.

(3) Lagoon sediment contamination. Contamination of the lagoon sediment is shown on drawing 2, which consists of a location map and a tabulation of results. Traverse 2 across the lagoon is shown on section C-C, drawing 6. Lead contamination is most severe near the southwest shore, in association with the burned fill, and drops off rapidly away from the burn area. Lead concentrations are greater than 21.1 mg/kg (background level in clay soil) in samples taken at the sediment/water interface. These concentrations are confined to the upper 1-foot of the sediment over approximately 75 percent of the lagoon; and are less than 200 mg/kg, except for the portion where burned fill exists, about 20 feet into the lagoon from shore. In this portion of the lagoon, where burned fill exists, lead concentrations are greater than 200 mg/kg and extend approximately three feet below the burned fill.

(4) Lagoon water contamination. All heavy metal concentration values from the three lagoon water samples taken were below drinking water standards. Most were below minimum reported values. These test results can be found in Appendix I.

(5) Groundwater contamination. Groundwater encountered at Site 20A.belongs to the Jackson/Quaternary aquifer. The gradient is very steep on the western half of the arsenal where the predominantly fine-grained materials of the Jackson Group are close to the surface; and nearly flat on the eastern half, sloping gently toward the Arkansas River through the terrace and flood plain deposits. This aquifer generally yields only very small amounts of poor quality water. The water is not drinking water quality and is not used for any purpose in the vicinity of the arsenal. The aquifer that supplies the drinking water to the area is the Sparta Sand, which is about 600 feet deep beneath the site. The Sparta is protected by the Jackson and upper Claiborne groups which have a low vertical permeability. Groundwater data is available from groundwater monitoring wells and from samples taken from several of the auger holes. Corps of Engineers groundwater data is tabulated in Appendix I, and AEHA groundwater data is tabulated on STORET, a computerized data base for surface water and groundwater administered by the U.S. Environmental Protection Agency. A summary of this data is given in table 3-3. Groundwater analyses confirm the fact that the contamination is primarily confined to the burned fill.

TABLE 3-3

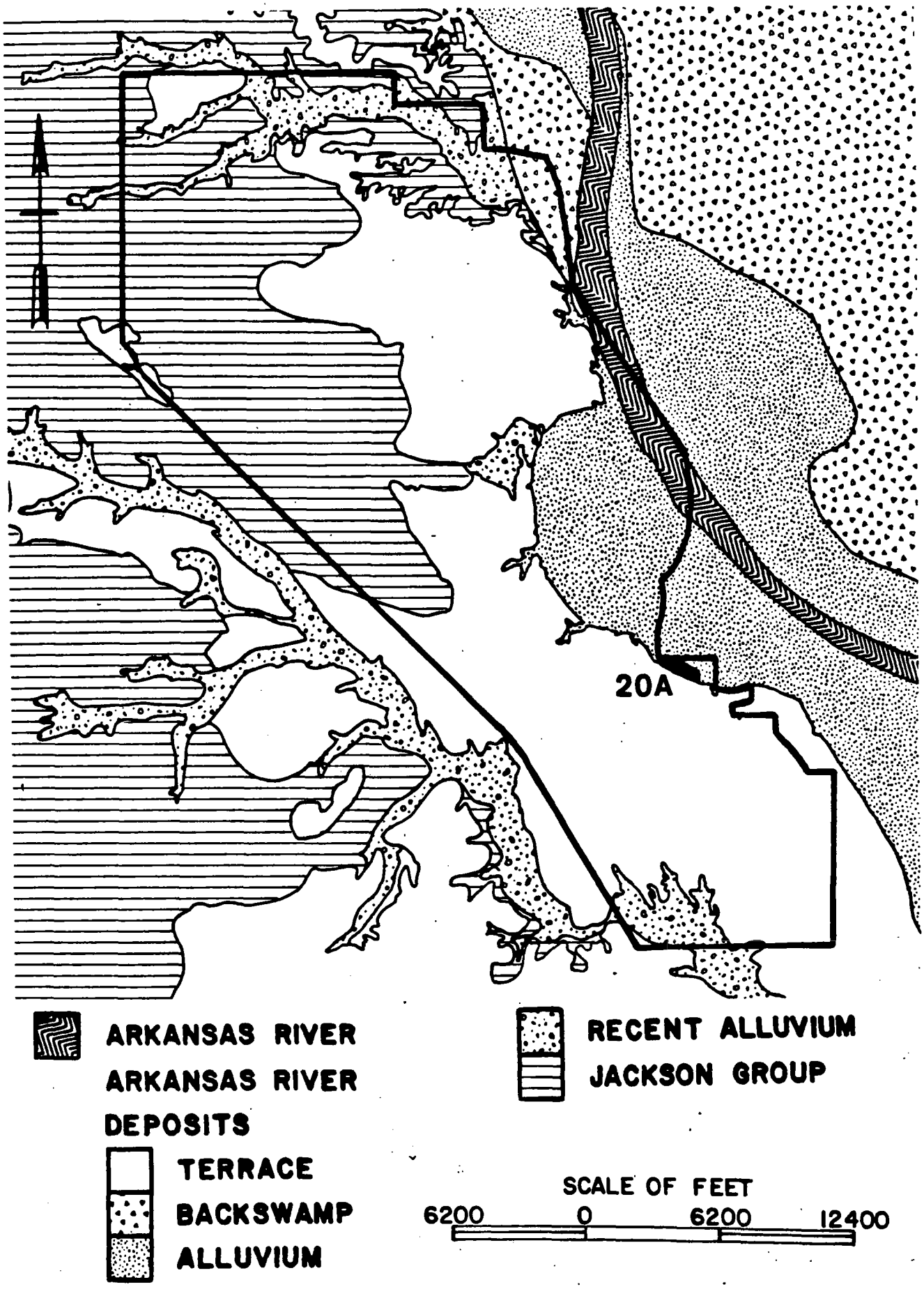
GROUNDWATER CHEMISTRY AT SITE 20A
(Values in mg/l)

	Barium		Lead		Zinc
	C of E	AEHA	C of E	AEHA	C of E
Downgradient Wells	.13-1.79	0-1.9	.02-.13	0-.01	.02-.08
Upgradient Wells	.11-.23	0-.50	.03-.04	0	.04-.09
Auger Holes 19 to 25	.11-2.63		.01-.05		.02-.70
Drinking water standards	1.0[1]		.05[1]		5.0[2]

[1]National Interim Primary Drinking Water Regulation
[2]Secondary Drinking Water Standard

3-05. Stratigraphic results.

As shown by the topography and monitoring well borings, Site 20A is located within the present flood plain of the Arkansas River. Figure 3-2 shows the location of Site 20A and the overall geologic environments at the arsenal. Geology from the drill holes is shown on geologic sections A-A through D-D, drawings 4 through 6. Field locations of these sections are shown on drawing 1. The deposits are all unconsolidated materials and consist of clay, silt, and sand. The clay is generally low plasticity with a liquid limit of 35 to 40 percent and a moisture content of 30 to 40 percent. A field permeability test conducted in hole 4 gave a value of 10^{-6} cm/sec for the clay. A laboratory permeability test on an undisturbed sample of this clay resulted in a value of 10^{-8} cm/sec. Section A-A, drawing 4, shows thicknesses of up to 25 feet of clay. The lateral extent of the clay strata thicker than 5 feet is shown on drawing 7. Several pockets of high plasticity clay with liquid limits above 60 also occur. Sand and silt predominate as shown on section B-B, drawing 5. The sand is generally silty and clayey with a permeability of about 10^{-5} cm/sec. This figure was calculated from recharge tests performed on the downgradient monitoring wells. The burned fill consists of incinerated debris and scrap metal. This material covers about 5 acres of the site and comprises about 53,000 cubic yards. As shown on sections C-C and D-D, drawing 6, this material is present as a thin veneer and thickens rapidly toward the lagoon. This material appears to have been pushed into the lagoon after burning operations and has a maximum thickness of 12 feet. The burned fill is several feet thick at the southwest shore of the lagoon and extends about 20 feet into the lagoon. The water table elevation equals the lagoon water surface at elevation 201.8, and is nearly flat across the site with an eastward gradient of less than 1 foot per mile toward the Arkansas River. The lagoon is fed by groundwater. As shown on the geologic sections, the water table occurs in the thicker portions of the burned fill as well as in both sand and clay.



PINE BLUFF ARSENAL - SURFACE GEOLOGY

FIGURE 3-2

3-06. Conclusions and recommendations. Based on results of geotechnical investigations at Site 20A, the following conclusions and recommendations are made:

a. Contaminants present. Toxic contaminants at Site 20A consist primarily of lead with lesser amounts of barium, cadmium, chromium, selenium, and silver. Zinc and total phosphate are also present in concentrations above background levels at the site.

b. Contamination extent. The contamination at Site 20A is confined to the burned fill material or the natural soil directly beneath. The natural clay stratum which is present beneath a portion of the site has been serving as an impermeable boundary for 40 years with neglible movement of contaminants either into the groundwater or natural soil.

c. Contaminant classification. All burned fill material and contaminated soils are non-hazardous wastes according to RCRA criteria.

d. Lagoon contamination. The lagoon sediment is badly contaminated only where burned fill material has been pushed into it. There is a natural clay stratum beneath a portion of the lagoon that would serve as a lower impermeable boundary for an encapsulation scheme. Additional borings along the trench axis will be required to verify the continuity and thickness of the underlying clay stratum if a portion of the encapsulation scheme is located within the lagoon area.

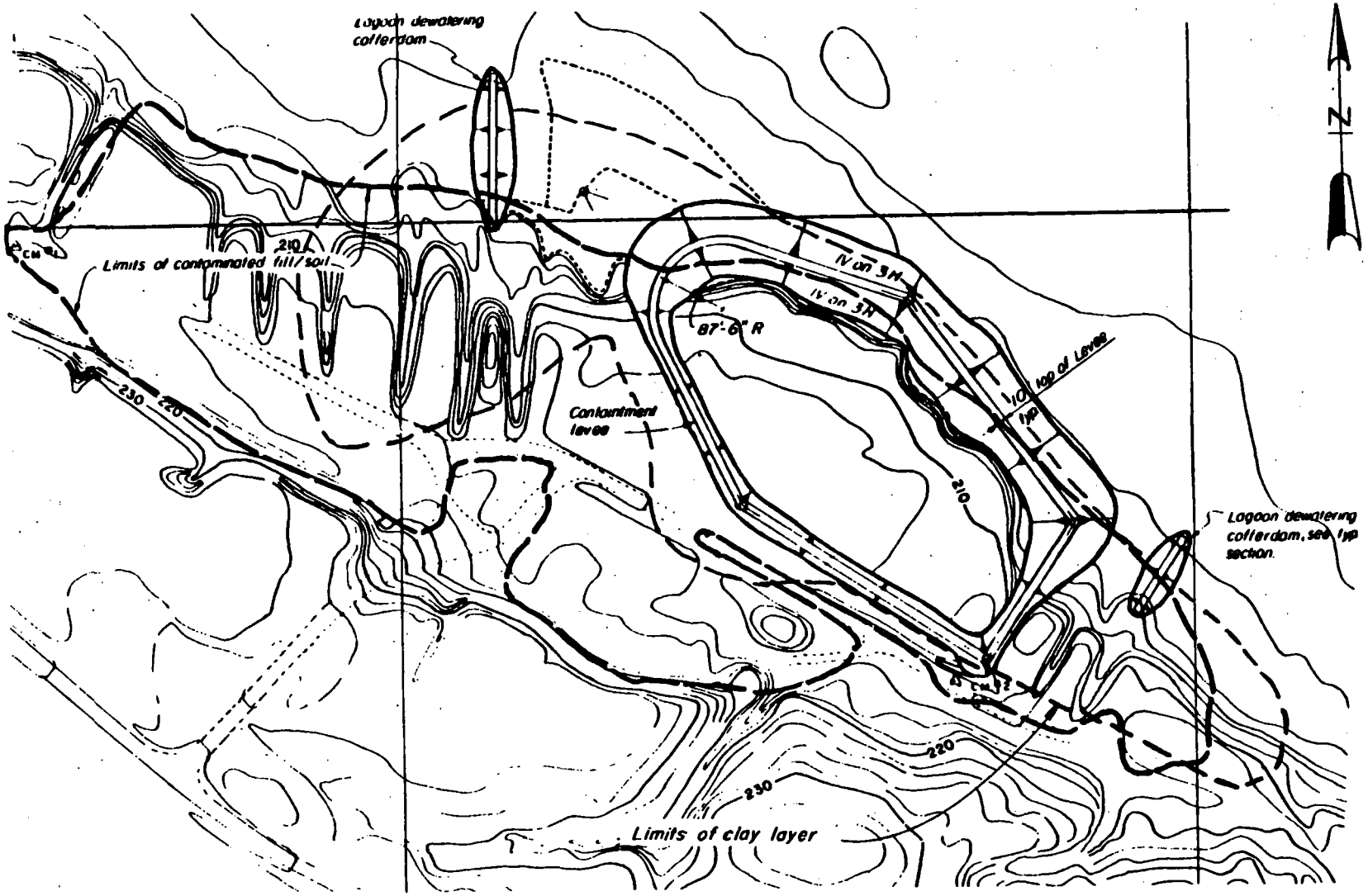
e. Closure scheme. A closure scheme is recommended that encapsulates the contaminated burned fill material in place and utilizes the natural clay stratum which is present beneath a portion of the site as a lower boundary. Since all material is non-hazardous by RCRA criteria, the burned fill and contaminated soil outside the limits of the suitable clay layer may be excavated and moved within the encapsulated area. Only burned fill and lead contaminated soil (approximately 58,000 cubic yards of material) would be encapsulated. A clay cover and cutoff trenches would complete the encapsulation. Final grading should be of a nature such that run-on is minimized onto the encapsulated material and run-off is diverted around the closed area. Construction sequencing should be planned so that run-off from disturbed areas during construction can be collected and tested before discharge.

IV - CLOSURE PLAN

4-01. General. The existence of the clay substrata discussed in Section 3 forms the basis for the proposed method of in situ encapsulation. It is planned to utilize this clay layer as the lower boundary of a closure cell. A containment levee would be keyed into the clay layer, the contaminated material placed within the levee, and the containment area and levee would be covered with a clay cap. This approach to an on-site closure plan is possible as EP Toxicity Tests performed on samples from the site proved negative. Therefore, the wastes are not subject to RCRA regulations, and the materials can be disturbed and put into a more compact arrangement for encapsulation. The proposed closure plan is shown on drawing 8, with the plan view reproduced in figure 4-1. Construction of this closure cell would be accomplished as follows:

a. Lagoon dewatering. The lagoon which borders the northern area of Site 20A would be cofferdammed at its east and west ends, then dewatered. Water quality tests indicate concentrations of heavy metals tested for in the lagoon water samples to be below EPA heavy metal standards for drinking water. Therefore the water will be pumped over the cofferdams and allowed to follow natural drainage away from the site.

b. Containment levee. Once the lagoon has been dewatered, the lagoon sediment would be stripped along the proposed levee alignment to expose the underlying clay. Stripping width along the levee alignment would equal the estimated width of the levee base at that point along the alignment, or 25 feet, whichever is greater. Stripping depth within the lagoon would be all lagoon sediment plus 6 inches of the clay layer, or 12 inches, whichever is greater. A key trench would then be excavated along the levee alignment. The key trench would be excavated 2 feet below the stripped base, have a 5 foot bottom width and IV on 2H side slopes. The key and containment levee would then be constructed from low-permeability fill. The containment levee would have a 10-foot crown width, IV on 3H side slopes, and a top elevation of 213.0 NGVD. Once the portion of the containment levee within the lagoon has been completed the "dry land" remainder of the key trench can be excavated and the key and containment levee completed. The stripping and key trench excavation remaining along the "dry land" portion of the containment levee alignment, and construction of the remaining containment levee, would also follow the same criteria indicated above. Construction of the containment levee in this sequence would provide a storage area for stripped/excavated material behind the "lagoon" portion of the containment levee thereby eliminating the need for a separate run-on/off control system during closure cell construction. The location and alignment of the containment levee as shown requires a minimum of contaminated fill movement since a large portion of the burned fill is enclosed within the proposed levee alignment. The containment levee will provide storage for the 58,000 estimated cubic yards of contaminated material, and would cover approximately five acres of the fifteen acre site. Approximately 24,000 cubic yards of the contaminated burned fill material exists in place within the confines of the proposed containment levee alignment and atop the clay layer being utilized as the lower boundary of the closure cell. The remaining 34,000 cubic yards of contaminated material would be stripped/excavated from the remainder of the site and placed within the confines of the levee.



PROPOSED CLOSURE PLAN

FIGURE 4-1

c. Cover and grading. Once all contaminated material has been placed within the levee it would be graded to provide a 5 percent slope for drainage away from its longitudinal axis. Then the cell would be capped with a 2-foot thick clay cover to prevent vertical migration of contaminants and to provide run-on/off control. The remainder of the site would be graded to provide sheet drainage away from the cell in a northwesterly direction. The entire disturbed area of the site and the closure cell would be covered with 6 inches of topsoil and revegetated.

d. Flood plain. The location of Site 20A is within the flood plain of the Arkansas River. Information from Pine Bluff Arsenal's Master Plan Basic Information Maps indicates the 100-year flood to extend approximately to elevation 222.0 within the area of Site 20A. This is 10 feet higher than the average elevation of 212.0 across Site 20A. However, potential closure cell integrity problems due to the site's location within flood plain are not anticipated for various reasons. The site is approximately 1-mile from the banks of the Arkansas River and is located at the extreme edge of the potential flooding area for a 100-year event. Corps of Engineers studies show that a compacted earth-fill structure with grass slope protection, the type of design utilized for this closure cell at Site 20A, can withstand flood current velocities of up to 6 feet per second before potential erosion problems begin to develop. Due to the site's location at the edge of the flood plain, velocities at or in excess of this figure are not anticipated.

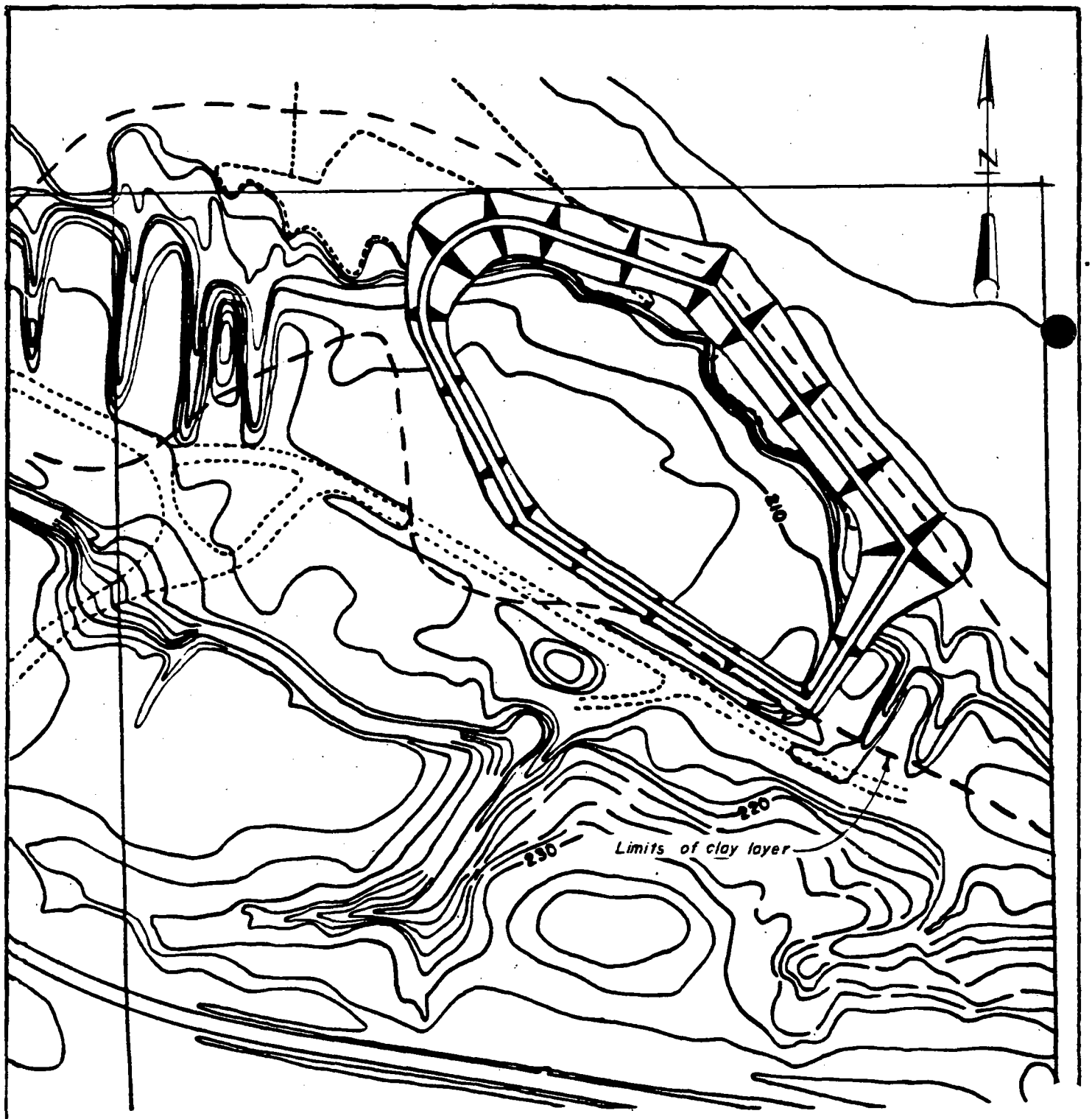
e. Operation and maintenance. The site would remain closed to burning or surface debris disposal indefinitely. The site would require maintenance for a period of approximately 2 years to prevent erosion until vegetative growth is firmly established. Periodic inspections would be conducted thereafter to insure against potential erosion problems. The groundwater monitoring wells would be sampled and tested every 6 months throughout the post closure period. It should be noted that, due to the existing groundwater hydrology and topography at Site 20A, the lagoon will, over time, be recharged and return to its normal water surface elevation. Dewatering operations will cease upon completion of the closure cell.

V - ALTERNATIVE CLOSURE PLANS

5-01. General. Two additional closure plans based upon an in situ encapsulation scheme were also reviewed.

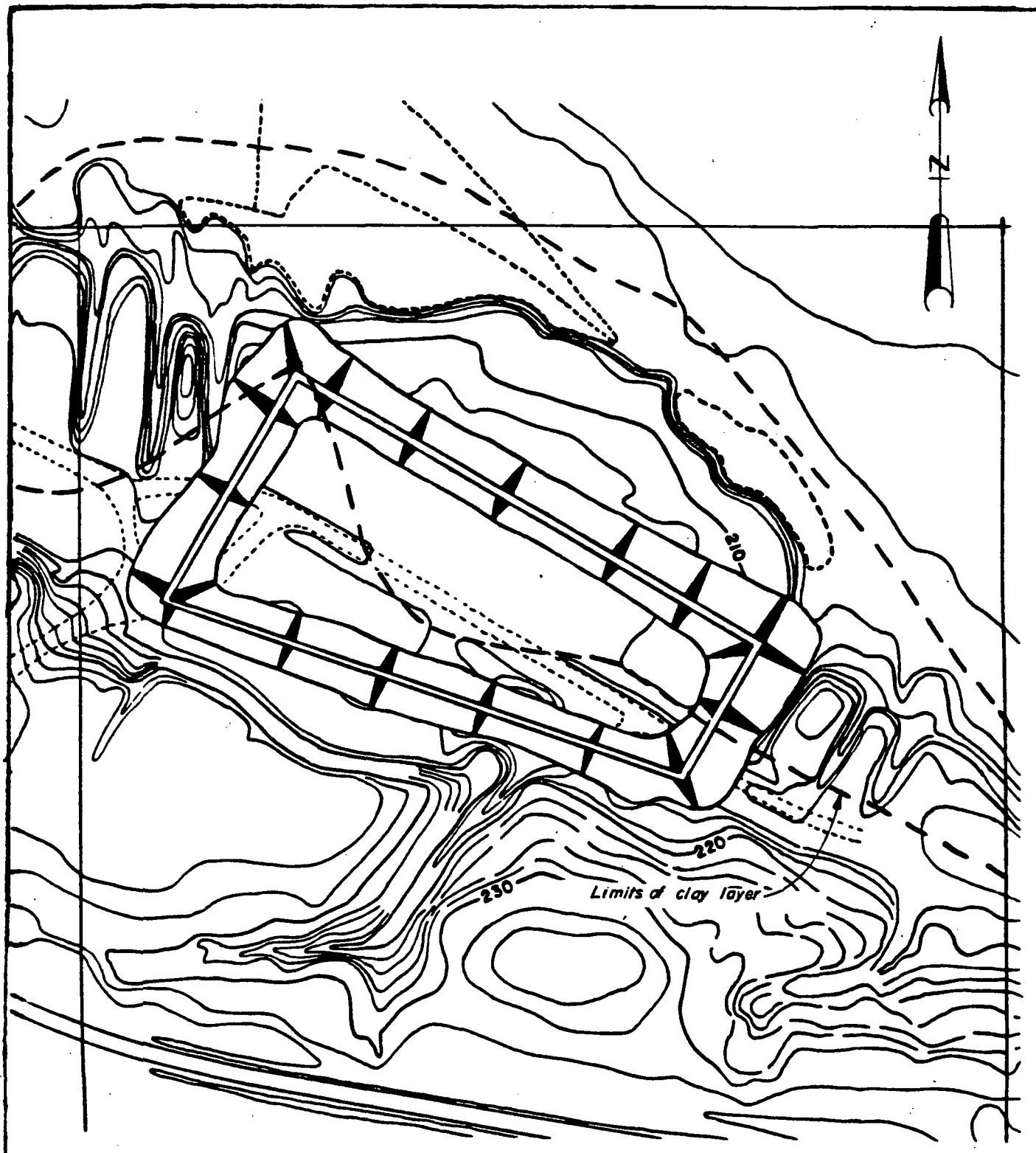
a. Alternative plan No. 1. Alternative plan No. 1, shown on figure 5-1, utilizes the same containment levee configuration as the scheme presented in Section 4, but is based upon levee construction via end dumping and dozing along the levee alignment into the lagoon. All criteria for stripping and excavation, and levee construction are the same as those mentioned in paragraph 4-01 b. Adequate compaction and an insured cut-off could not be guaranteed with this alternative, nor would it allow clean-up of any lagoon sediments along the dike alignment. These factors plus the additional cost to construct a levee via end dumping, as shown in Section 6, eliminated this alternative from further consideration and design effort.

b. Alternative plan No. 2. Alternative plan No. 2, shown on figure 5-2, assumes the lagoon was to be left as a marginal wildlife habitat and could not be dewatered. This plan utilizes a containment levee alignment which is located totally on "dry land". This alternative requires the bottom clay liner of the closure cell to be installed as the clay substrata does not exist as a continous layer where the "dry land" containment levee alignment was sited. This levee also required a larger embankment to store the 58,000 cubic yards of contaminated fill. As with the first alternative, this plan would not allow for any lagoon sediment clean-up along the shoreline; and the actions of excavating the contaminated materials from the lagoon's shore would increase the amount of contaminants within the lagoon. A separate run-on/run-off structure would be required for contaminated fill stockpiled during the construction period. These factors plus the higher costs associated with this alternative, as shown in Section 6, eliminated it from further consideration and design effort.



ALTERNATIVE CLOSURE PLAN NO. 1

FIGURE 5-1



ALTERNATIVE CLOSURE PLAN NO. 2

FIGURE 5-2

VI - COSTS

6-01. General. Unit prices are based on average bid prices for similar type projects constructed or under construction in the Tulsa District and adjusted to October 1986 price levels.

a. Borrow availability. It was assumed that all low-permeability fill would be supplied from an approved borrow source located on arsenal property and a 10-mile haul distance was assumed to the site for unit cost purposes. Unit cost differentials for low-permeability fill line items are due to varying methods of placement. An available borrow source for topsoil was assumed to be located on arsenal grounds with a 10-mile haul distance to the site used for unit cost purposes. Detailed borrow area investigations would be conducted during the final design to confirm the availability of low-permeability fill and top soil in sufficient quantities within a 10-mile haul distance.

b. Dewatering. Lagoon dewatering costs assume direct pumping of water over cofferdams to natural drainage paths. These costs would require reevaluation should it be determined during subsequent investigations that this water must undergo treatment at the arsenal's Pollution Abatement Facility prior to discharge to the environment.

6-02. Cost comparison of closure plans. A comparison of the costs for the proposed closure plan and the two alternative closure plans presented is shown in table 6-1.

TABLE 6-1

COST COMPARISON
(October 1986 Price Levels)

ITEM	PROPOSED CLOSURE PLAN	ALTERNATIVE CLOSURE No. 1	ALTERNATIVE CLOSURE No. 2
	$	$	$
Site Preparation	33,320	6,920	2,830
Closure Cell Earthwork	405,230	448,970	542,290
Contaminated Fill Movement	76,840	76,840	131,080
Site Grading and Revegetation	94,360	94,360	94,360
Subtotal	609,750	627,090	770,560
Contingencies @ 10%+	60,950	62,710	77,060
Total Contract Cost	670,700	689,800	847,620
Supervision and Inspection @ 5.5%+	36,900	37,900	46,580
TOTAL	707,600	727,700	894,200

EXHIBIT

EXHIBIT A
SITE PHOTOGRAPHS

Photograph I

View of western lagoon area and burned fill, looking west.

Photograph 2

View of central lagoon area and burned fill, looking east.

Photograph 3

Lagoon/burned fill interface

Photograph 4

Lagoon/burned fill interface

Photograph 5

Lagoon along proposed containment levee alignment

Photograph 6

View of eastern lagoon area and burned fill

APPENDICES

APPENDIX I
LABORATORY, CHEMISTRY AND SOIL REPORTS

SWD LABORATORY REPORT 13657

Notes on Test Methods

All analyses were performed in accordance with Procedures for Handling and Chemical Analysis of Sediment and Water Samples, Environmental Laboratory, U. S. Army Engineers Waterways Experiment Station, Vicksburg, Mississippi (1981).

Soil samples analyzed for chromium, cadmium, lead, zinc, barium and silver were prepared by acid digestion and analyzed for total metals by direct flame atomic absorption.

Arsenic was analyzed by arsine generation, selenium by hydride generation, and mercury by cold vapor technique.

EP Toxicity samples were prepared in accordance with section 7.0 of EPA 846 Test Methods for Evaluating Solid Waste. Analyses for the various parameters were performed by the same techniques as those described for soil samples.

Table No. 1

Results of Tests of All Soil Samples for Lead and Zinc

SWD Sample No. G-	Field Sample No.	Depth	Pb	Zn
3783	PBA-20A, Hole 1- 1	0.0- 3.0	6.2	142.6
3784	- 2	3.0- 5.0	6.2	57.3
3785	- 3	5.0- 6.0	11.5	76.2
3786	- 4	6.0- 9.0	9.4	32.6
3787	- 5	9.0-11.0	11.8	52.1
3788	- 6	11.0-14.0	7.3	24.2
3789	- 7	14.0-17.0	7.4	61.8
3790	- 8	17.0-19.0	5.0	23.7
3791	- 9	19.0-22.0	9.2	26.8
3792	-10	22.0-24.0	6.5	21.3
3793	-11	24.0-26.0	13.0	26.5
3794	-12	26.0-28.0	2.5	15.8
3795	-13	28.0-29.0	11.3	27.3
3796	-14	29.0-32.0	4.7	23.9
3797	-15	32.0-35.0	1.0	18.8
3798	-16	35.0-38.0	3.9	12.9
3799	-17	38.0-41.0	5.0	16.4
3800	PBA-20A, Hole 2- 1	0.0- 0.8	<1.0	1.0
3801	- 2	0.8- 3.8	6.0	1.4
3802	- 3	3.8- 5.0	28.9	128.8
3803	- 4	5.0- 6.5	12.7	46.1
3804	- 5	6.5- 9.5	9.3	63.1
3805	- 6	9.5-12.5	1.6	9.3
3806	- 7	12.5-15.5	<1.0	13.2
3807	- 8	15.5-17.0	5.4	28.2
3808	- 9	17.0-18.0	7.5	10.3
3809	-10	18.0-20.5	3.0	12.8
3810	-11	20.5-23.5	2.3	7.8
3811	-12	23.5-26.5	2.1	4.5
3812	-13	26.5-29.5	2.4	3.1
3813	-14	29.5-32.5	2.7	2.2
3814	-15	32.5-35.5	2.8	4.0
3815	-16	35.5-40.0	8.6	1.2
3816	PBA-20A, Hole 3- 1	0.0- 0.5	85.6	224.7
3817	- 2	0.5- 3.0	77.5	970.7
3818	- 3	3.0- 6.0	202.8	1763.9
3819	- 4	6.0- 9.0	305.6	878.0
3820	- 5	9.0-10.8	35.5	4871.7
3821	- 6	10.8-13.8	22.3	124.6
3822	- 7	13.8-16.8	6.8	92.2
3823	- 8	16.8-19.8	13.3	46.5
3824	- 9	19.8-22.8	9.2	41.2
3825	-10	22.8-25.8	8.7	38.0
3826	-11	25.8-29.0	7.9	25.3
Detection Limit			1.0	1.0

Table No. 1 (Cont'd)

Results of Tests of All Soil Samples for Lead and Zinc

SWD Sample No. G-	Field Sample No.	Depth	Pb	Zn
3827	PBA-20A, Hole 3-12	29.0-32.5	3.0	21.5
3828	-13	32.5-36.0	6.7	34.0
3829	-14	36.0-38.0	2.7	23.5
3830	-15	38.0-39.5	12.3	31.2
3831	PBA-20A, Hole 4- 1	0.0- 3.5	16.6	< 1.0
3832	- 2	3.5- 6.5	258.9	4240.0
3833	- 3	6.5- 9.5	589.2	4365.7
3834	- 4	9.5-12.5	19.9	140.4
3835	- 5	12.5-15.5	14.4	89.8
3836	- 6	15.5-18.5	9.8	128.1
3837	- 7	18.5-21.5	14.1	94.7
3838	- 8	21.5-24.0	6.3	50.6
3839	- 9	24.0-26.0	5.9	71.8
3840	-10	26.0-27.8	4.9	40.6
3841	-11	27.8-29.4	16.5	77.9
3842	-12	29.4-31.0	9.8	56.8
3843	-13	31.0-34.0	5.4	53.8
3844	-14	34.0-36.0	5.2	45.7
3845	PBA-20A, Hole 5- 1	0.0- 4.5	313.5	76.8
3846	- 2	4.5-10.0	609.7	3961.9
3847	- 3	10.0-13.0	8.2	55.5
3848	- 4	13.0-16.0	15.1	127.4
3849	- 5	16.0-19.0	19.3	61.4
3850	- 6	19.0-22.0	17.4	84.6
3851	- 7	22.0-25.0	10.3	58.1
3852	- 8	25.0-26.5	5.8	32.5
3853	- 9	26.5-29.5	8.6	55.7
3854	-10	29.5-31.5	9.3	52.8
3855	-11	31.5-34.0	11.5	76.8
3856	-12	34.0-36.0	4.7	23.1
3857	PBA-20A-SD-1	Lagoon Sediment	681.6	3970.9
3858	-2	"	1076.2	7709.1
3859	-2	"	234.4	1524.3
Detection Limit			1.0	1.0

All result are reported in mg/kg.

Results of Tests of Selected Soil Samples for Total Metals

SWD Sample No.	Field Sample No.	Depth	As	Ba	Cd	Cr	Hg	Se	Ag
3816	PBA-20A, Hole 3- 1	0.0- 0.5	<1.0	123.4	1.5	<5.0	<0.1	0.18	0.5
3817	- 2	0.5- 3.0	4.54	526.8	0.7	38.5	<0.1	0.27	0.9
3818	- 3	3.0- 6.0	17.48	366.0	3.4	40.9	<0.1	0.80	7.5
3819	- 5	6.0- 9.0	30.94	448.7	9.0	77.8	<0.1	0.85	7.3
3820	- 5	9.0-10.8	6.18	717.9	2.1	<5.0	<0.1	0.51	2.3
3821	- 6	10.8-13.8	8.80	134.4	<0.5	10.3	<0.1	0.55	1.6
3831	PBA-20A, Hole 4- 1	0.0- 3.5	<1.0	113.2	<0.5	<5.0	<0.1	0.66	<0.5
3832	- 2	3.5- 6.5	11.07	277.5	9.0	73.7	<0.1	0.78	2.3
3833	- 3	6.5- 9.5	13.59	677.0	18.6	85.7	0.2	1.11	6.8
3834	- 4	9.5-12.5	9.45	64.4	<0.5	5.3	<0.1	0.96	0.7
3835	- 5	12.5-15.5	8.50	104.6	<0.5	6.5	<0.1	0.42	<0.5
3836	- 6	15.5-18.5	4.11	40.6	<0.5	6.0	<0.1	0.48	<0.5
Detection Limit			1.0	40.0	0.5	5.0	0.1	0.10	0.5

(1) All results are reported in mg/kg

Results of Tests of Metals for EP Toxicity(1)

SWD Sample No.	Field Sample No.	Depth	As	Ba	Cd	Cr	Pb	Hg	Se	Ag
3818	PBA-20A, Hole 3-3	3.0-6.0	.00075	3.2	.010	< .010	.05	.0002	.01	< .01
3833	PBA-20A, Hole 4-3	6.5-9.5	.00075	3.6	.110	< .010	.17	< .0001	.02	< .01
3858	PBA-20A SD- 2	-	.0018	3.6	.015	< .010	< .01	.0002	.02	< .01
Minimum Reported Concentration			.00075	0.7	.002	.010	.010	.0001	.004	.01

(1) All results are reported in mg/l.

SWD LABORATORY REPORT 13657a

Table 1

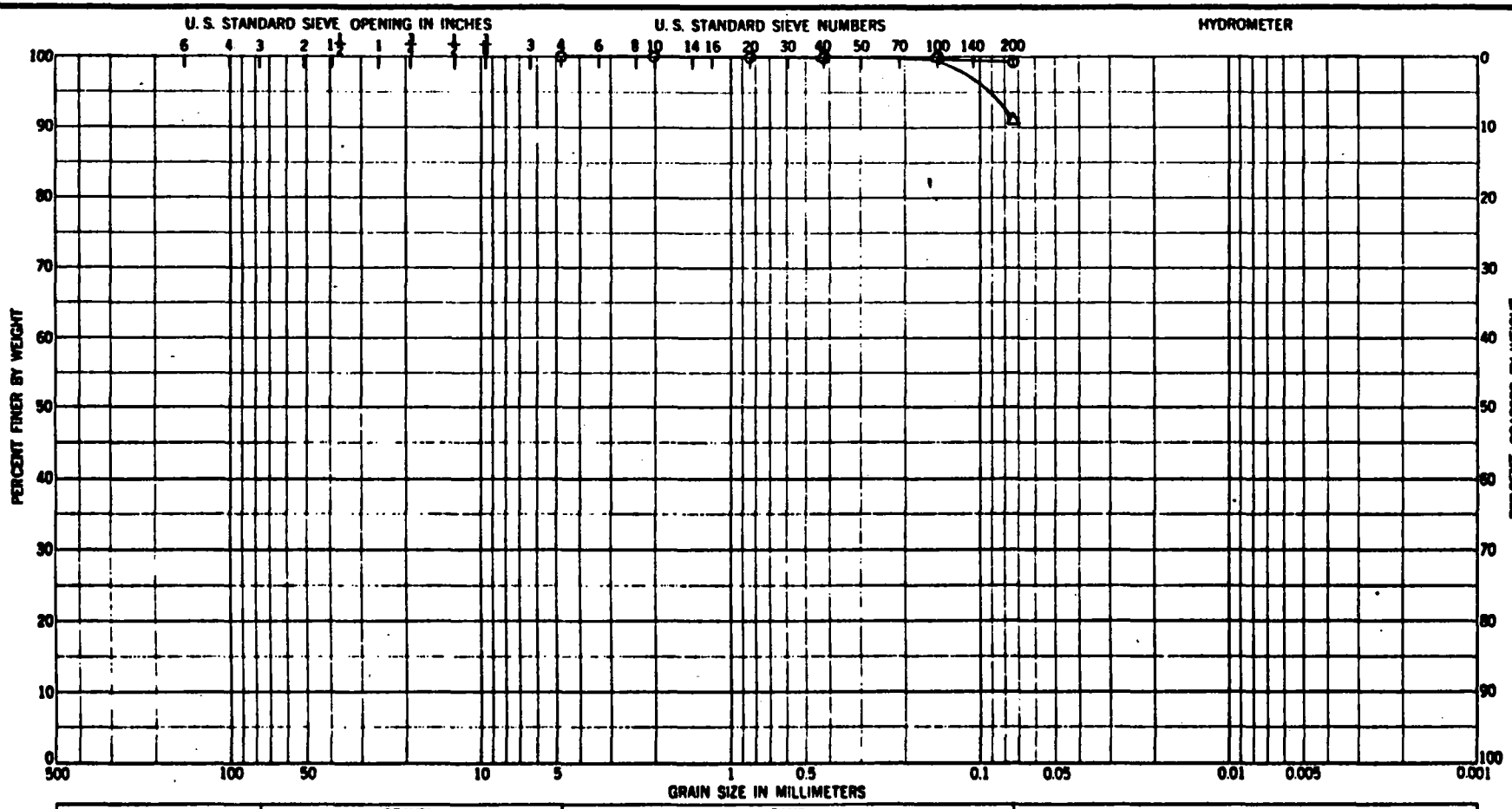
Results of Tests of Disturbed Soil Samples

Boring No.	Field No.	SWD No.	Depth ft.	Mechanical Analysis Gr	Sa	Fi	Atterberg Limits LL	PL	PI	LS	Water Content %		Description
20A-1	J-2	83/3784	3.0- 5.0								21.0	ML	SILT, sandy, brown, moist.
	J-4	83/3786	6.0- 9.0	0	1	99	30	20	10		27.9	CL	CLAY, brown, moist.
	J-7	83/3789	14.0-17.0								29.0	ML	SILT, sandy, dark brown, very moist.
	J-10	83/3792	22.0-24.0	0	9	91	25	20	5		30.6	ML-CL	SILT, brown, very moist.
	J-12	83/3794	26.0-28.0	0	25	75	NP	NP	NP		25.0	ML	SILT, sandy, brown, moist.
	J-13	83/3795	28.0-29.0								55.4	CH	CLAY, dark reddish brown, moist.
	J-16	83/2798	35.0-38.0	0	20	80	NP	NP	NP		23.9	ML	SILT, sandy, brown, moist.
20A-2	J-2	83/3801	0.8- 3.8	12	63	25	49	42	7		30.7	SC-SM	SAND, clayey, black, highly organic. This material consists mainly of some type of burnt residue.
	J-4	83/3803	5.0- 6.5	0	2	98	50	20	30		32.5	CH	CLAY, light gray, moist.
	J-6	83/3805	9.5-12.5	0	43	57	NP	NP	NP		16.1	ML	SILT, sandy, brown, moist.
	J-8	83/3807	15.5-17.0	0	14	86	21	18	3		26.9	ML	SILT, brown, very moist.
	J-11	83/3810	20.5-2-.5	0	57	43	NP	NP	NP		21.5	SM	SAND, silty, light brown, moist.
	J-13	83/3812	26.5-29.5								17.5	SM	SAND, silty, light brown, moist.
	J-15	83/3814	32.5-35.5								16.2	SM	SAND, silty, light brown, moist.
20A-3	J-7	83/3822	13.5-16.5	1	1	98	62	23	39		50.1	CH	CLAY, dark brown, very moist.
	J-10	83/3825	22.8-25.8	0	1	99	66	23	43		43.0	CH	CLAY, dark brown, moist.

Table 1

Results of Tests of Disturbed Soil Samples

Boring No.	Field No.	SWD No.	Depth ft.	Mechanical Analysis Gr	Sa	Fi	Atterberg Limits LL	PL	PI	LS	Water Content %		Description
20A-3	J-13	83/3828	32.5-36.0	1	25	74	21	20	1		29.0	ML	SILT, sandy, brown, very moist.
	J-14	83/3829	36.0-38.0								28.3	ML	SILT, sandy, dark brown, very moist.
	J-15	83/3830	38.0-40.0								36.6	CL	CLAY, dark brown, moist.
20A-4	J-4	83/3834	9.5-12.5	2	4	94	35	19	16		36.4	CL	CLAY, dark brown, very moist.
	J-7	83/3837	18.5-21.5	0	3	97	66	24	42		55.4	CH	CLAY, dark brown, very moist.
	J-9	83/3839	24.0-26.0	0	12	88	27	18	9		31.6	CL	CLAY, dark brown, very moist.
	J-11	83/3841	27.8-29.4								44.1	CH	CLAY, dark brown, moist.
	J-14	83/3844	34.0-36.0	0	14	86	24	21	3		31.1	ML	SILT, dark brown, very moist.
20A-5	J-4	83/3848	13.0-16.0	0	2	98	57	22	35		47.3	CH	CLAY, dark brown, moist.
	J-7	83/3851	22.0-25.0	0	5	95	37	18	19		35.6	CL	CLAY, dark brown, moist.
	J-8	83/3852	25.0-26.5								26.0	ML	SILT, sandy, dark brown, very moist.
	J-10	83/3854	29.5-31.5	1	7	92	39	19	20		31.9	CL	CLAY, dark brown, moist.
	J-12	83/3856	34.0-36.0	0	31	69	21	19	2		28.5	ML	SILT, sandy, dark brown, moist.



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
83/3786 o	6.0-9.0	CLAY (CL)	27.9	30	20	10
83/3792 Δ	22.0-24.0	SILT (ML-CL)	30.6	25	20	5

GRADATION CURVES

Project: Pine Bluff Arsenal

Area:

Boring No. 20A-1

Date: October 83

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Plate 1

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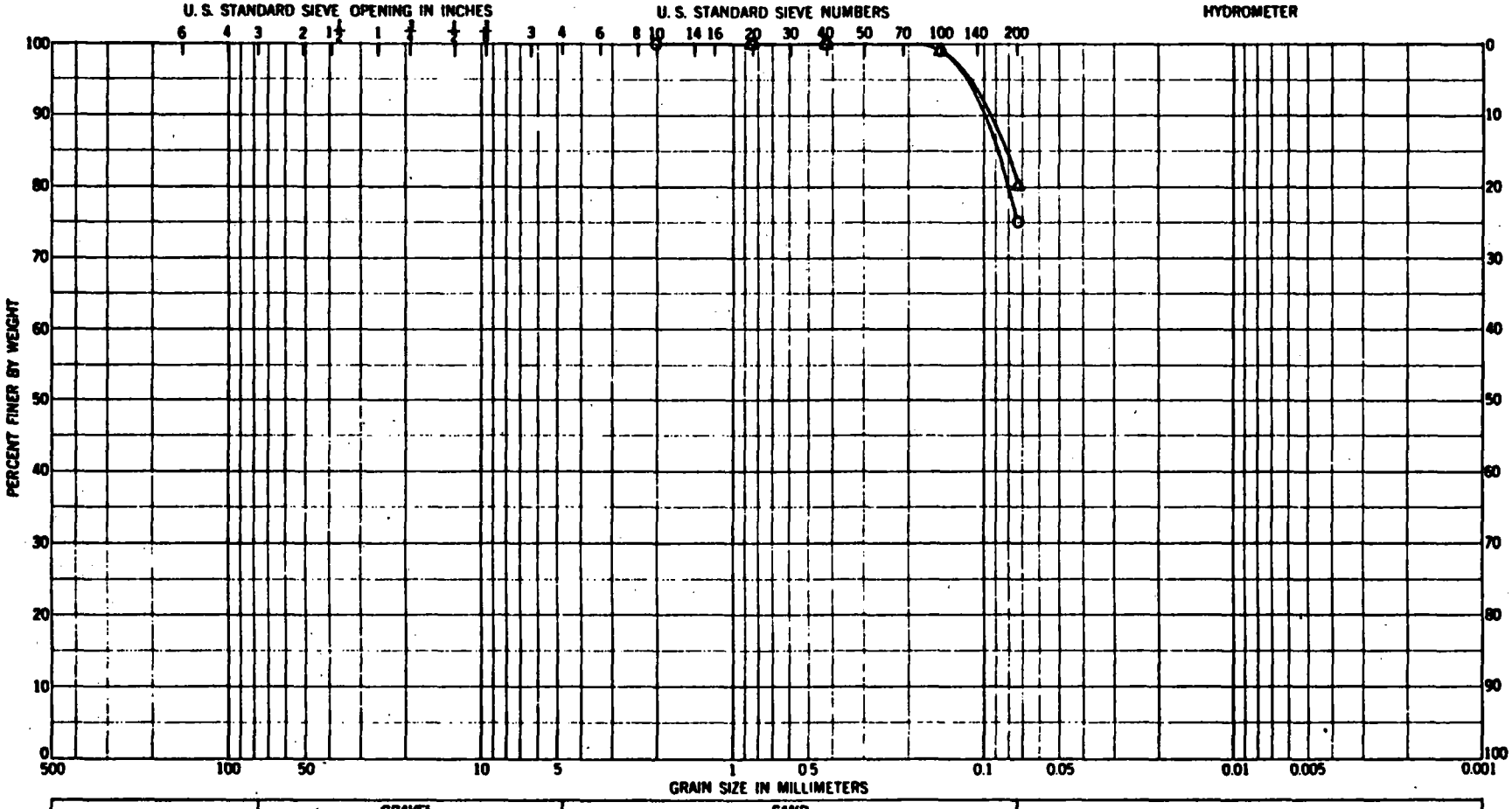

Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
83/3794 o	26.0-28.0	SILT, sandy (ML)	25.0	NP	NP	NP
83/3798 Δ	35.0-38.0	SILT, sandy (ML)	23.9	NP	NP	NP

GRADATION CURVES

Project Pine Bluff Arsenal

Area

Boring No. 20A-1

Date October 83

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Plate 2

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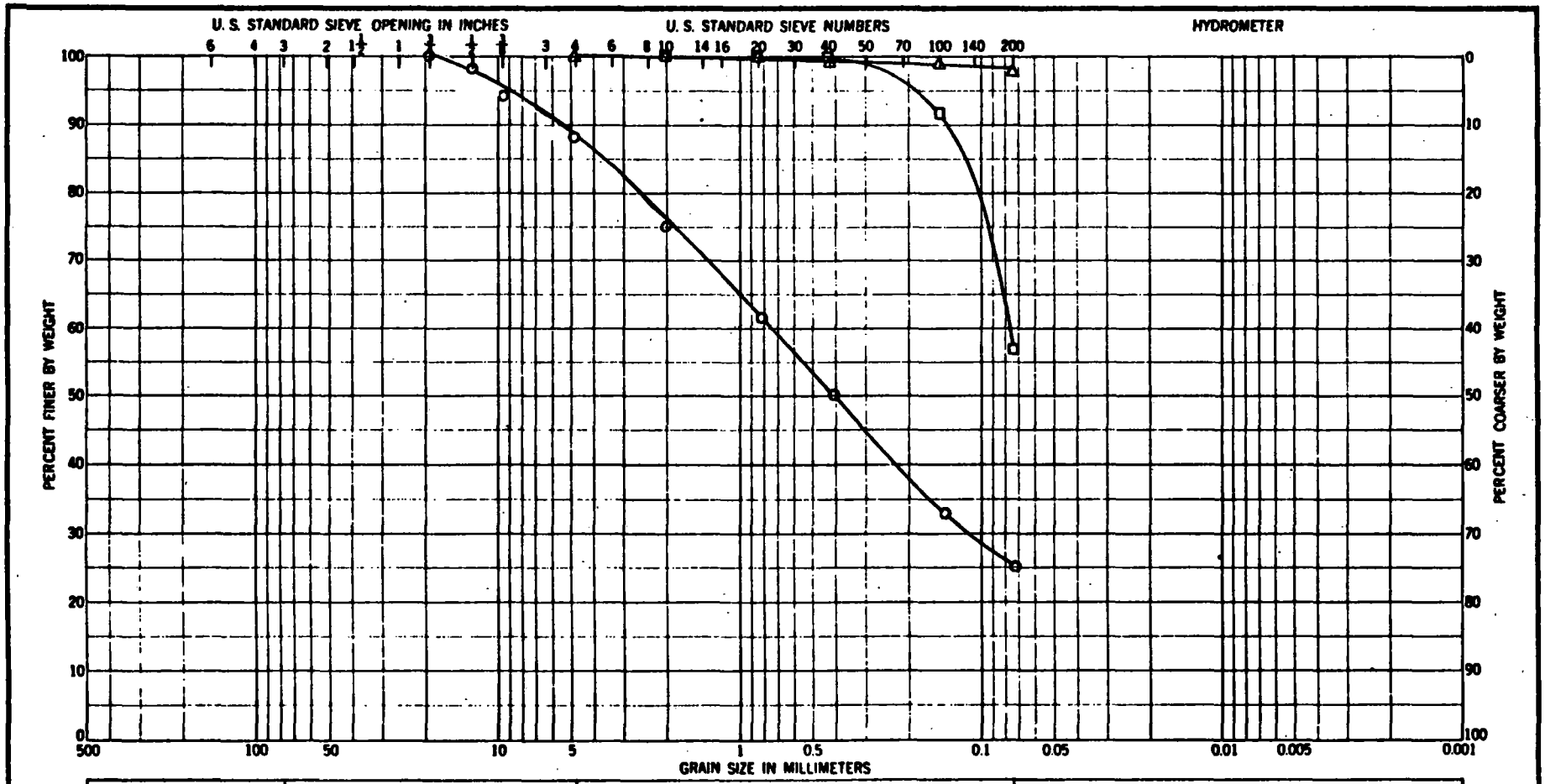

Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
83/3801 ○	0.8-3.8	SAND, clayey (SC-SM)	30.7	49	42	7
83/3803 △	5.0-6.5	CLAY (CH)	32.5	50	20	30
83/3805 □	9.5-12.5	SILT, sandy (ML)	16.1	NP	NP	NP

GRADATION CURVES

Project Pine Bluff Arsenal

Area

Boring No. 20A-2

Date October 83

Plate 3

SWDED-GL Report No. 13657a

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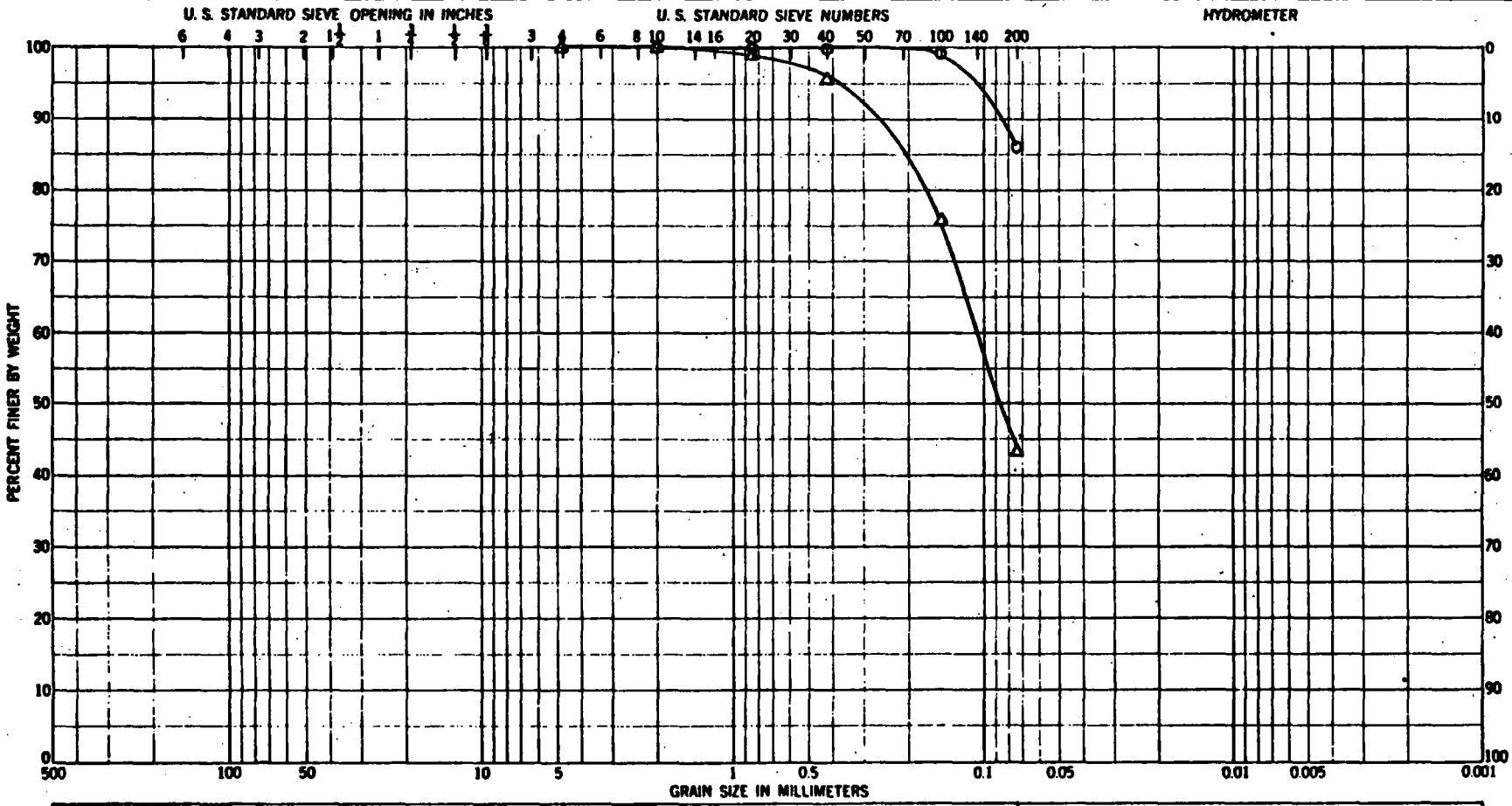

Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
83/3807 ○	15.1-17.0	SILT (ML)	26.9	21	18	3
83/3810 △	20.5-23.5	SAND, silty (SM)	21.5	NP	NP	NP

GRADATION CURVES

Project Pine Bluff Arsenal

Area

Boring No. 20A-2

Date October 83

Plate 4

SWDED-GL Report No. 13657a

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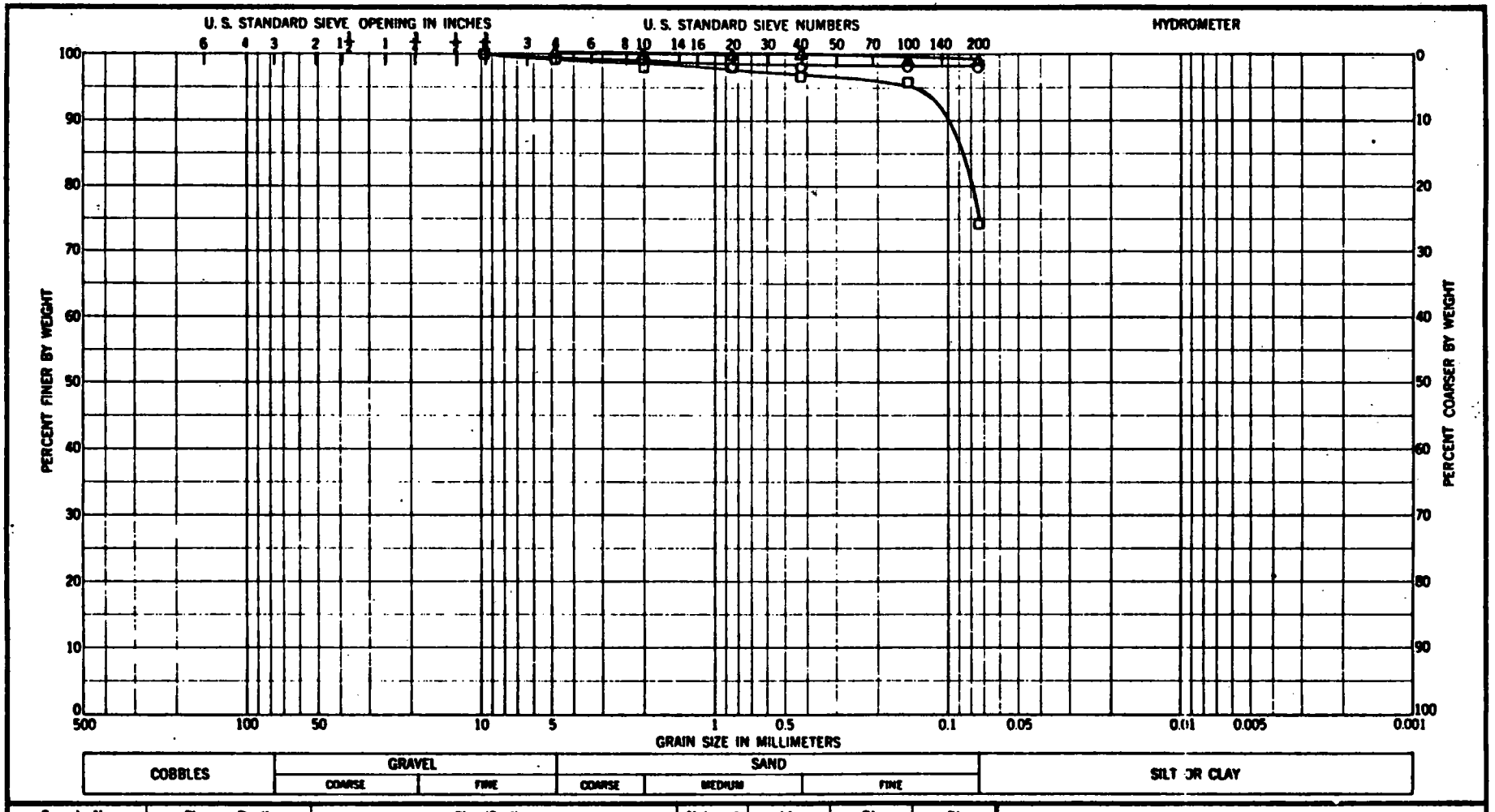

Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
83/3822 ○	13.5-16.5	CLAY (CH)	50.1	62	23	39
83/3825 △	22.8-25.8	CLAY (CH)	43.0	66	23	43
83/3828 □	32.5-36.0	SILT,sandy (ML)	29.0	21	20	1

GRADATION CURVES

Project Pine Bluff Arsensl

Area

Boring No. 20A-3

Date October 83

Plate 5

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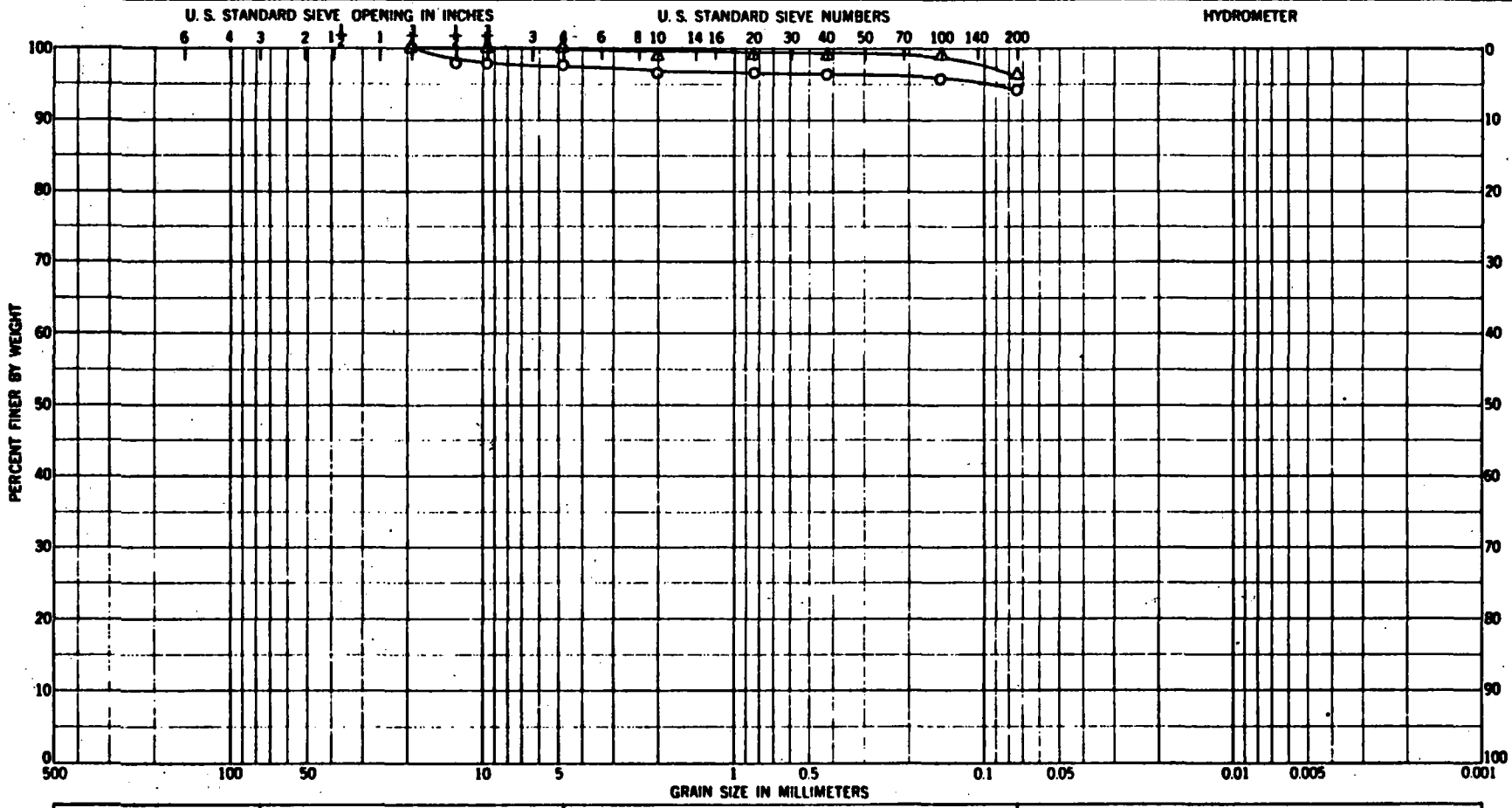

Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
83/3834 ○	9.5-12.5	CLAY (CL)	36.4	35	19	16
83/3837 △	18.5-21.5	CLAY (CH)	55.4	66	24	42

GRADATION CURVES

Project Pine Bluff Arsenal

Area

Boring No. 20A-4

Date October 83

Plate 6

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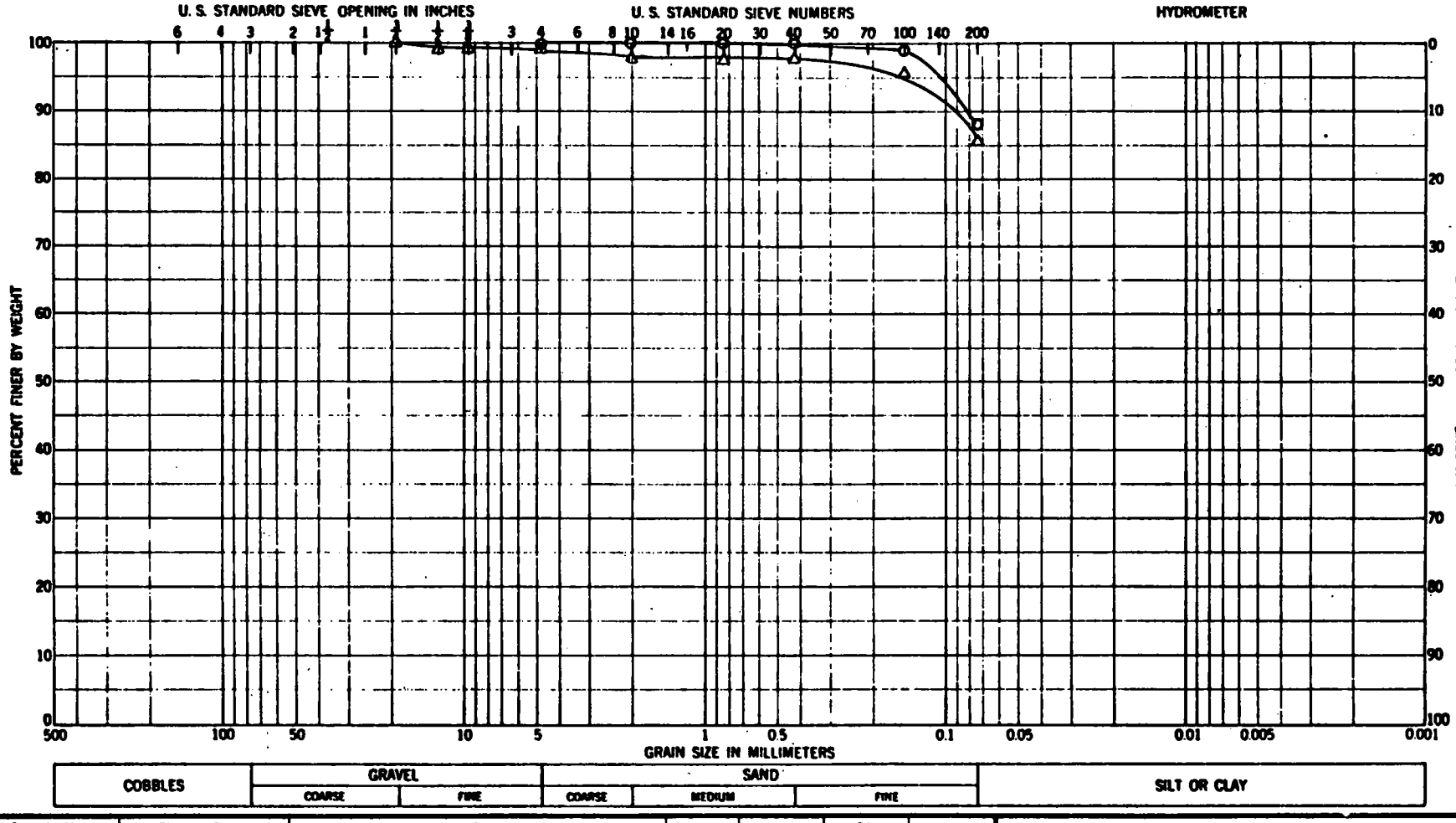

Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
83/3839 ○	24.0-26.0	CLAY (CL)	31.6	27	18	9
83/3844 △	34.0-36.0	SILT (ML)	31.1	24	21	3

GRADATION CURVES

Project Pine Bluff Arsenal

Area

Boring No. 20A-4

Date October 83

Plate 7

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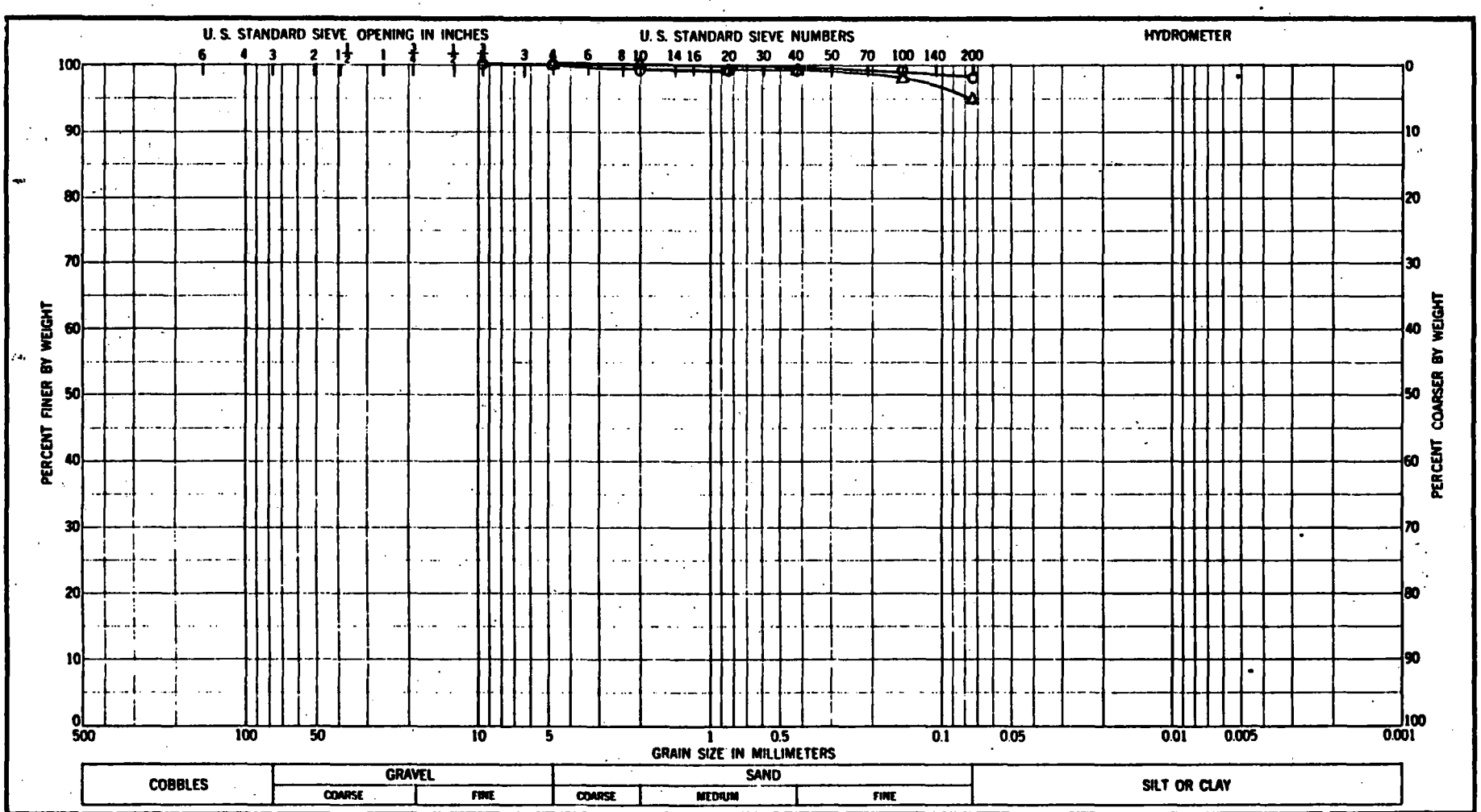


Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
83/3848 ○	13.0-16.0	CLAY (CH)	47.3	57	22	35
83/3851 △	22.0-25.0	CLAY (CL)	35.6	37	18	19

GRADATION CURVES

Project Pine Bluff Arsenal

Area

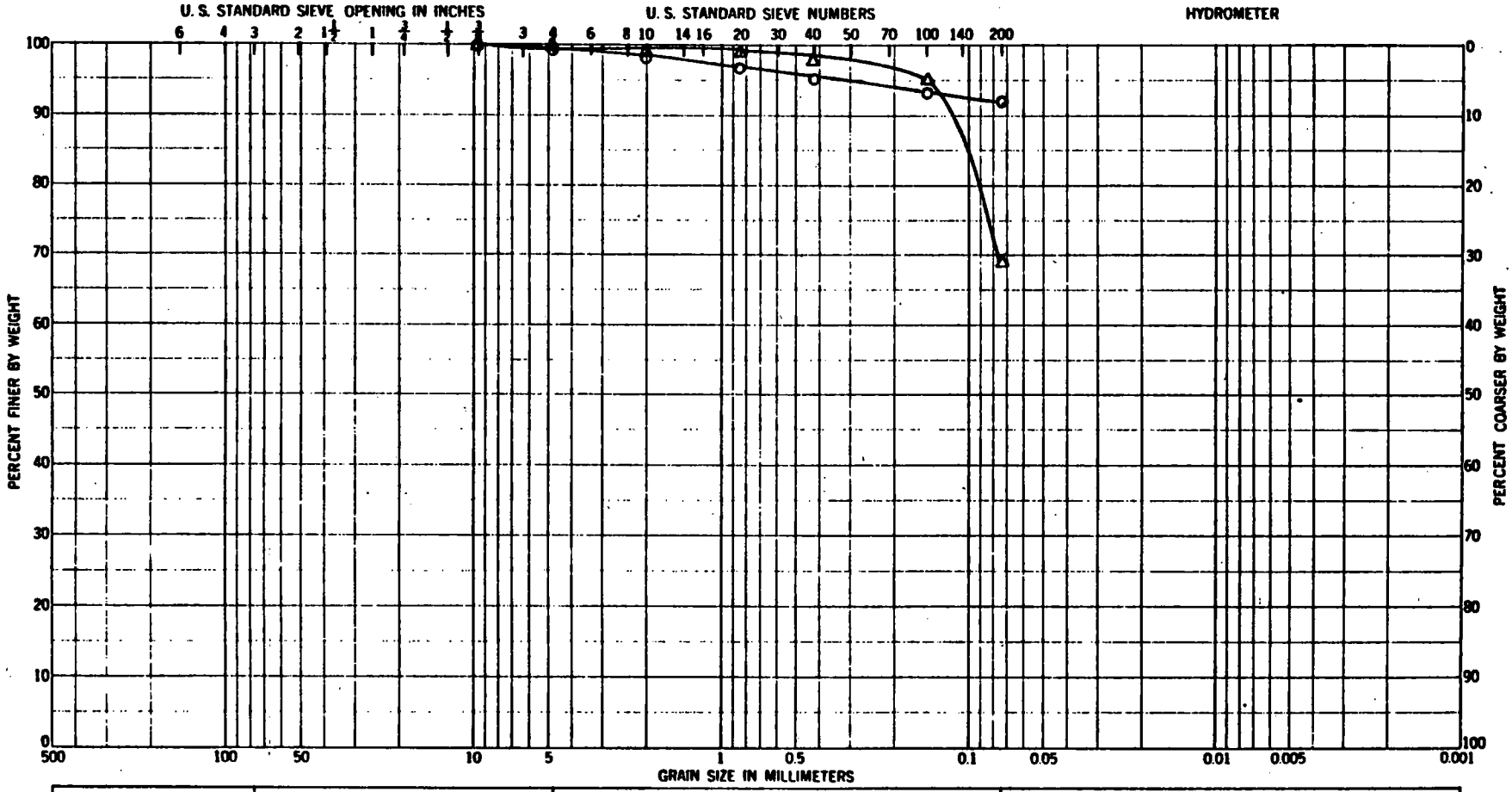
Boring No. 20A-5

Date October 83

Plate 8

SWDED-GL Report No. 13657a

ENG FORM 1 MAY 63 2087



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
83/3854 ○	29.5-31.5	CLAY (CL)	31.9	39	19	20
83/3856 △	34.0-36.0	SILT, sandy (ML)	28.5	21	19	2

GRADATION CURVES

Project Pine Bluff Arsenal

Area

Boring No. 20A-5

Date October 83

SWDED-GL Report No. 13657a

Plate 9

ENG FORM 1 MAY 63 2087

SWD LABORATORY REPORT 13657-1

Results of Chemical Analysis of Soils[1]

SWD Lab No. G-	Field Sample No.	Depth	Ag	As	Ba	Cd	Cr	Hg	Pb	Se	Zn	Total Phosphate
3831	20A-4 -1	0.0- 3.5										133
3832	-2	3.5- 6.5										1211
3837	20A-4 -7	18.5-21.5		8.9	68.8							
3838	-8	21.5-24.0		7.3	50.7							
3839	-9	24.0-26.0		3.5	56.4							
3840	-10	26.0-27.8		3.4	27.4							
3841	-11	27.8-29.4		9.3	64.7							
3842	-12	29.4-31.0		8.1	88.2							
3843	-13	31.0-34.0		4.3	25.6							
3844	-14	24.0-26.0		3.3	27.4							
3845	20A-5 -1	0.0- 4.5										674
3846	-2	4-5-10.0										1023
3861	20A-6 -1	0.0- 2.5	<0.05	5.8	21.7	<0.5	13.8	0.1	61.5	1.4	70.9	
3862	-2	2.5- 5.5	<0.05	7.7	39.0	0.5	< 5.0	< 0.1	1.8	7.8	102.8	
3863	-3	5.5- 8.5	<0.05	2.6	25.0	<0.5	11.0	< 0.1	7.5	2.3	39.2	
3866	-6	14.5-17.5	<0.05	1.1	<20.0	<0.5	< 5.0	<0.1	3.1	1.9	9.9	
3870	-10	27.0-30.0	<0.05	5.8	<20.0	<0.5	< 5.0	< 0.1	1.4	2.1	20.0	
3874	20A-7 -1	0.0- 3.0							8.6		30.7	
3875	-2	3.0- 6.0							8.3		22.3	
3876	-3	6.0- 9.0							7.3		17.9	
3877	-4	9.0-12.0							2.5		13.2	
3889	20A-8 -1	0.0- 3.0							3.6		15.9	
3890	-2	3.0- 6.0							14.0		35.3	
3891	-3	6.0- 9.0							2.0		17.1	
3892	-4	9.0-12.0							10.5		26.2	
3903	20A-9 -1	0.4- 3.4			23.5							
3904	-2	3.4- 6.4			42.7							
3905	-3	6.4- 9.4			< 20.0							
3906	-4	9.4-12.4			< 20.0							
Minimum reportable value			0.5	1.0	20.0	0.5	5.0	0.1	1.0	1.0	1.0	25.0

Results of Chemical Analysis of Soils(1)

SWD Lab No G-	Field Sample No.	Depth	Ag	As	Ba	Cd	Cr	Hg	Pb	Se	Zn	Total Phosphate
3916	20A-10-1	0.0- 2.8			65.9				10.9		71.0	
3917	-2	2.8- 5.8			<20.0				4.0		11.6	
3918	-3	5.8- 8.8			<20.0				2.6		10.2	
3919	-4	8.8- 9.8			20.7				4.4		11.9	
3930	20A-11-1	0.0- 1.2							987.3		10050.6	
3931	-2	1.2- 4.8							2763.2		3605.2	
3932	-3	4.8- 7.8							5.9		55.0	
3933	-4	7.8-10.8							6.8		60.0	
3934	-5	10.8-13.8							14.8		60.8	
3935	-6	13.8-16.8							14.3		36.5	
3936	-7	16.8-20.0							7.6		28.4	
3944	20A-12-1	0.0- 3.0			<20.0				9.2		20.6	
3945	-2	3.0- 6.5			57.5				5.7		35.6	
3946	-3	6.5- 9.5			99.8				15.5		41.1	
3947	-4	9.5-12.5			65.8				10.4		28.4	
3948	-5	12.5-16.0			59.5				4.3		20.0	
3949	-6	16.0-19.0			25.0				3.0		14.5	
3950	-7	19.0-21.5			25.2				3.1		10.5	
3958	20A-15-2	0.1- 1.0	<0.5	3.4	25.8	<0.5	5.6	<0.1	96.5	<1.0	10.9	30
3959	-3	1.0- 1.5	<0.5	4.5	51.0	<0.5	<5.0	<0.1	14.2	<1.0	26.0	118
3961	-5	1.5- 2.0	<0.5	10.3	126.3	<0.5	<5.0	<0.1	15.3	<1.0	46.3	477
3963	-7	3.0- 6.0	<0.5	5.0	33.8	0.5	7.0	<0.1	16.4	<1.0	34.9	409
3965	-9	9.0-10.5	<0.5	5.2	59.0	0.5	<5.0	<0.1	12.8	<1.0	62.1	302
3967	-11	13.0-16.0	<0.5	1.5	40.0	<0.5	<5.0	<0.1	4.5	<1.0	20.0	217
3971	20A-16-2	0.1- 1.0	<0.5	3.5	45.2	<0.5	<5.0	<0.1	4.8	<1.0	16.6	36
3973	-4	2.0- 3.0	<0.5	9.5	120.0	0.5	<5.0	<0.1	17.3	<1.0	64.8	568
3975	-6	6.0- 7.5	<0.5	13.1	104.2	0.6	8.0	<0.1	13.6	<1.0	43.9	579
3977	-8	10.5-13.5	<0.5	2.4	43.2	<0.5	<5.0	<0.1	5.9	<1.0	23.5	282
3980	-11	18.0-20.0	1.1	6.0	88.9	6.6	7.2	<0.1	18.9	<1.0	61.7	396
Minimum reportable values			0.5	1.0	20.0	0.5	5.0	0.1	1.0	1.0	1.0	25.0

(1) All results are reported in mg/kg.

Table 2

Results of Chemical Analysis of EP Toxicity Sample(1)

SWD Lab No.	Field Sample No.	Depth	Ba	Pb
3834-EP	20A-4-4	9.5-12.5	0.20	0.04
Minimum Reportable Value			0.10	0.01

(1) All results are reported in mg/l.

SWD LABORATORY REPORT 13657-1a

Table 1

Results of Tests of Disturbed Soil Samples

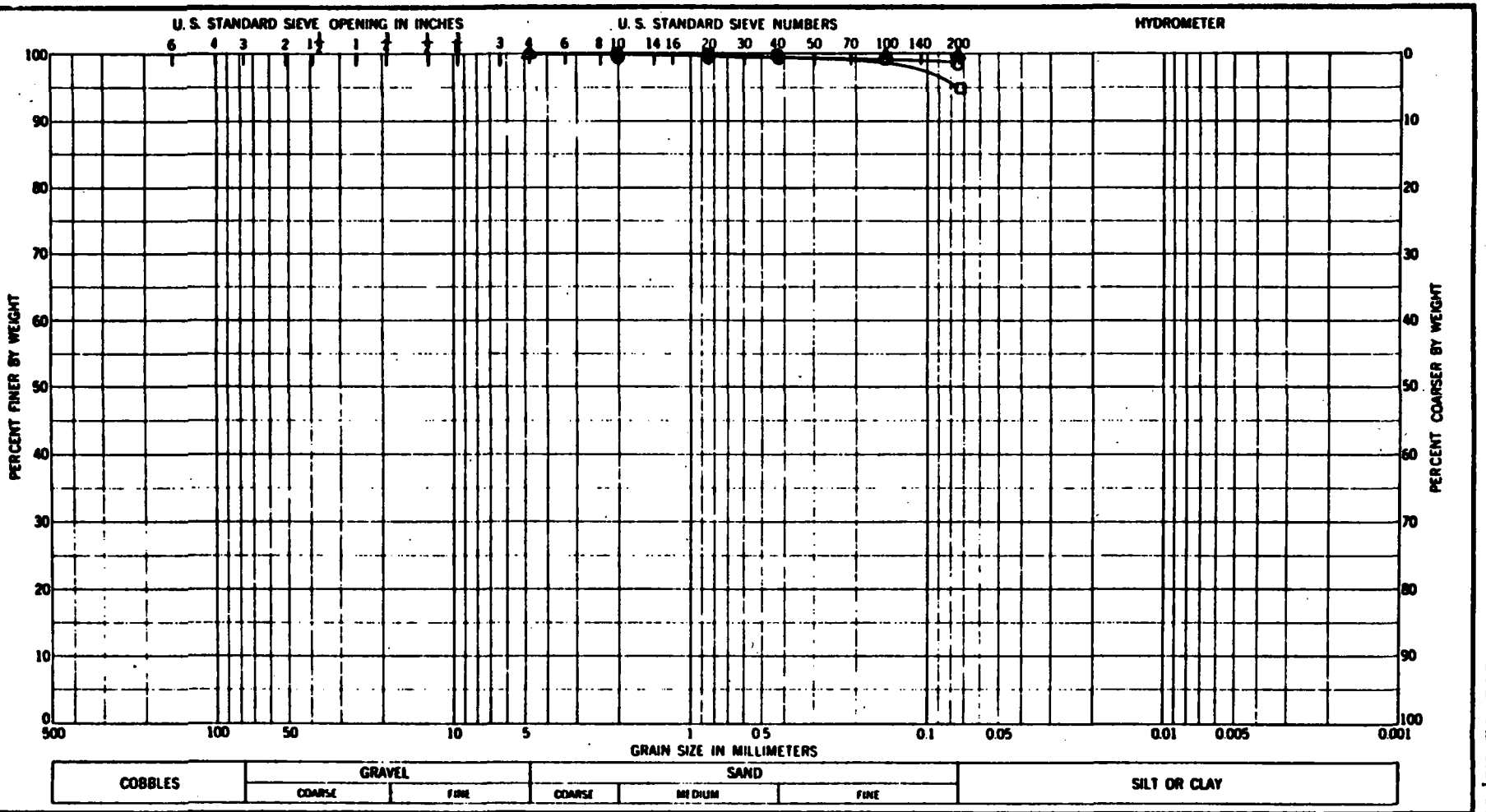
Boring No.	Field No.	SWD No.	Depth ft.	Mechanical Analysis Cr	Sa	Fi	Atterberg Limits LL	PL	PI	LS	Water Content %		Description
20A-6	J-2	83/3862	2.2- 5.5	0	2	98	50	20	30		31.6	CH	CLAY
	J-3	83/3863	5.5- 8.5	0	0	100	25	21	4		28.2	ML-CL	SILT
	J-6	83/3866	14.5-17.5								21.4	ML	SILT, sandy, brown, moist.
	J-10	83/3870	27.0-30.0	0	5	95	56	19	37		38.1	CH	CLAY
20A-7	J-2	83/3875	3.0- 6.0	0	10	90	31	16	15		12.1	CL	CLAY
	J-3	83/3876	6.0- 9.0								16.0	ML	SILT, brown, moist.
	J-6	83/3879	15.0-18.0	0	14	86	30	19	11		31.2	CL	CLAY
	J-8	83/3881	21.0-23.0								32.0	ML	SILT, dark brown, wet.
20A-8	J-3	83/3891	6.0- 9.0	0	5	95	30	20	10		27.9	CL	CLAY
	J-7	83/3895	17.0-20.0								30.4	ML	SILT, dark brown, wet.
	J-9	83/3897	22.5-25.5								29.6	ML	SILT, dark brown, very moist.
20A-9	J-2	83/3904	3.4- 6.4	0	21	79	NP	NP	NP		12.7	ML	SILT, sandy.
	J-6	83/3908	15.4-18.4								31.3	ML	SILT, brown, wet.
	J-8	83/3910	22.4-25.8	0	12	88	37	18	19		32.8	CL	CLAY.
	J-11	83/3913	31.0-34.0								27.4	ML	SILT, brown, wet.
20A-10	J-1	83/3916	0.0- 2.8	3	8	89	36	21	15		23.9	CL	CLAY
	J-5	83/3920	9.9-12.9								21.4	ML	SILT, brown, moist.

Results of Tests of Disturbed Soil Samples

Boring No.	Field No.	SWD No.	Depth ft.	Mechanical Analysis Gr	Sa	Fi	Atterberg Limits LL	PL	PI	LS	Water Content %		Description
20A-10	J-8	83/3923	18.8-21.8	0	43	57	20	18	2		25.5	ML	SILT, sandy.
20A-11	J-3	83/3932	4.8- 7.8	0	5	95	34	19	15		38.4	CL	CLAY.
	J-5	83/3934	10.8-13.8								33.4	ML	SILT, dark brown, moist, wet.
	J-7	83/3936	16.8-20.0	0	8	92	33	17	16		29.0	CL	CLAY.
	J-10	83/3939	26.0-29.0								30.2	ML	SILT, dark brown, wet.
20A-12	J-2	83/3945	3.0- 6.5	0	28	72	29	15	14		16.9	CL	CLAY, sandy.
	J-5	83/3948	12.5-16.0								26.9	ML	SILT, brown, very moist.
	J-7	83/3950	19.0-21.5	0	52	48	NP	NP	NP		20.6	SM	SAND, silty.
	J-9	83/3952	24.5-27.5								32.5	CL	CLAY, brown, moist.
20A-13	J-2	83/3983	1.5- 4.5								14.5	ML	SILT, brown, moist.
	J-4	83/3985	7.0-10.5	0	6	94	23	21	2		27.5	ML	SILT.
	J-7	83/3988	16.0-19.0								21.8	ML	SILT, gray, very moist.
	J-10	83/3991	25.0-28.0								26.0	SM	SAND, silty, yellow, wet.
20A-14	J-3	83/3998	4.8- 7.8	0	1	99	49	19	30		25.9	CL	CLAY.
	J-5	83/4000	10.0-13.0								23.0	ML	SILT, brown, very moist.
	J-6	83/4001	13.0-16.0	0	18	82	23	19	4		26.8	ML-CL	SILT.

Results of Tests of Disturbed Soil Samples

Boring No.	Field No.	SWD No.	Depth ft.	Mechanical Analysis Gr	Sa	Fi	Atterberg Limits LL	PL	PI	LS	Water Content %		Description
20A-15	J-2	83/3958	0.1- 1.0	0	57	43	NP	NP	NP		6.8	SM	SAND, silty.
	J-3	83/3959	1.0- 1.5								12.2	CL	CLAY, light yellowish brown, damp.
	J-5	83/3961	1.5- 2.0								22.1	CL	CLAY, sandy, grayish brown, moist.
	J-7	83/3963	3.0- 6.0	0	6	94	40	19	21		34.9	CL	CLAY.
	J-9	83/3965	9.0-10.5	0	3	97	41	19	22		36.2	CL	CLAY.
	J-11	83/3967	13.0-16.0								22.8	ML	SILT, sandy, brown, very moist.
20A-16	J-2	83/3971	0.1- 1.0								14.2	CL	CLAY, yellowish brown, moist.
	J-4	83/3973	2.0- 3.0	0	5	95	64	23	41		33.2	CH	CLAY.
	J-6	83/3975	6.0- 7.5								41.1	CL	CLAY, brown, very moist.
	J-8	83/3977	10.5-13.5	0	35	65	NP	NP	NP		24.3	ML	SILT, sandy.
	J-11	83/3980	18.0-20.0								52.3	CL	CLAY, brown, very moist.



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
83/3862 o	2.2-5.5	CLAY (CH)	31.6	50	20	30
83/3863 Δ	5.5-8.5	SILT (ML-CL)	28.2	25	21	4
83/3870 □	27.0-30.0	CLAY (CH)	38.1	56	19	37

GRADATION CURVES

Project Pine Bluff Arsenal

Area

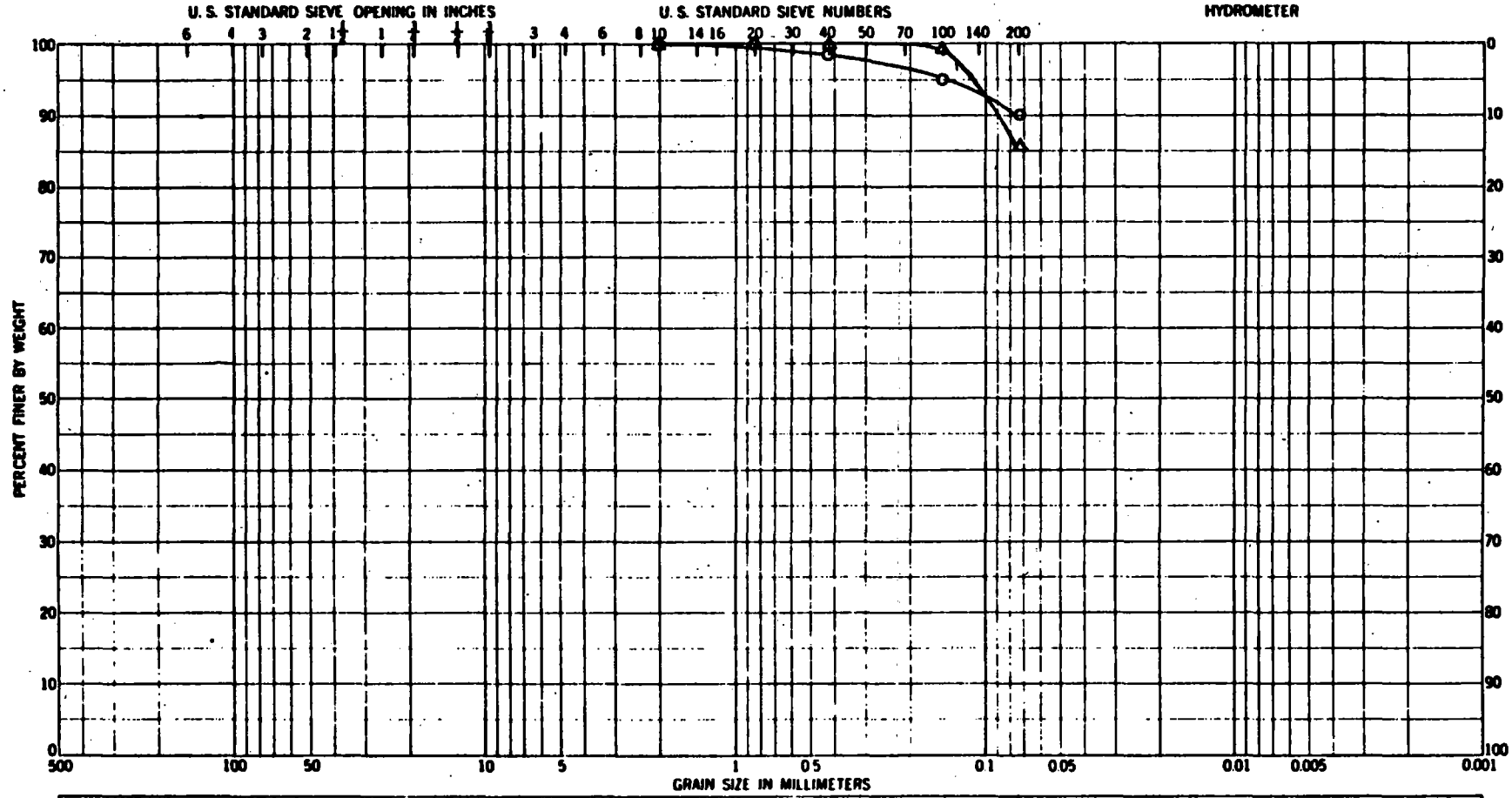
Boring No. 20A-6

Date October 83

Plate 1

SWDED-GL Report No. 13657-1a

ENG FORM 1 MAY 63 2087



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
83/3875 ○	3.0-6.0	CLAY (CL)	12.1	31	16	15
83/3879 △	15.0-18.0	CLAY (CL)	31.2	30	19	11

GRADATION CURVES

Project Pine Bluff Arsenal

Area

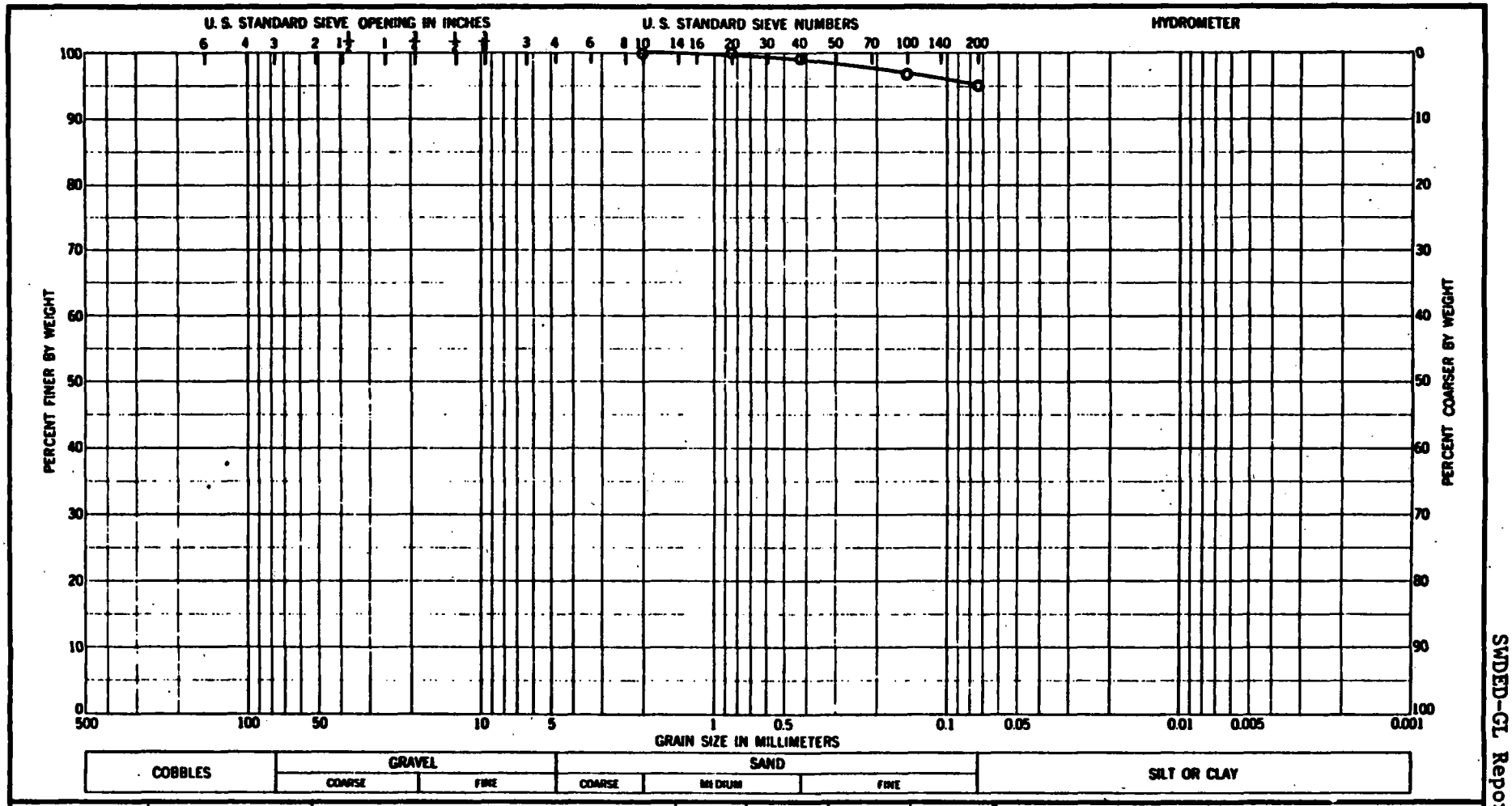
Boring No. 20A-7

Date October 83

Plate 2

SWDED-GL Report No. 13657-1a

ENG FORM 1 MAY 63 2087



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
83/3891 o	6.0-9.0	CLAY (CL)	27.9	30	20	10

GRADATION CURVES

Project Pine Bluff Arsenal

Area

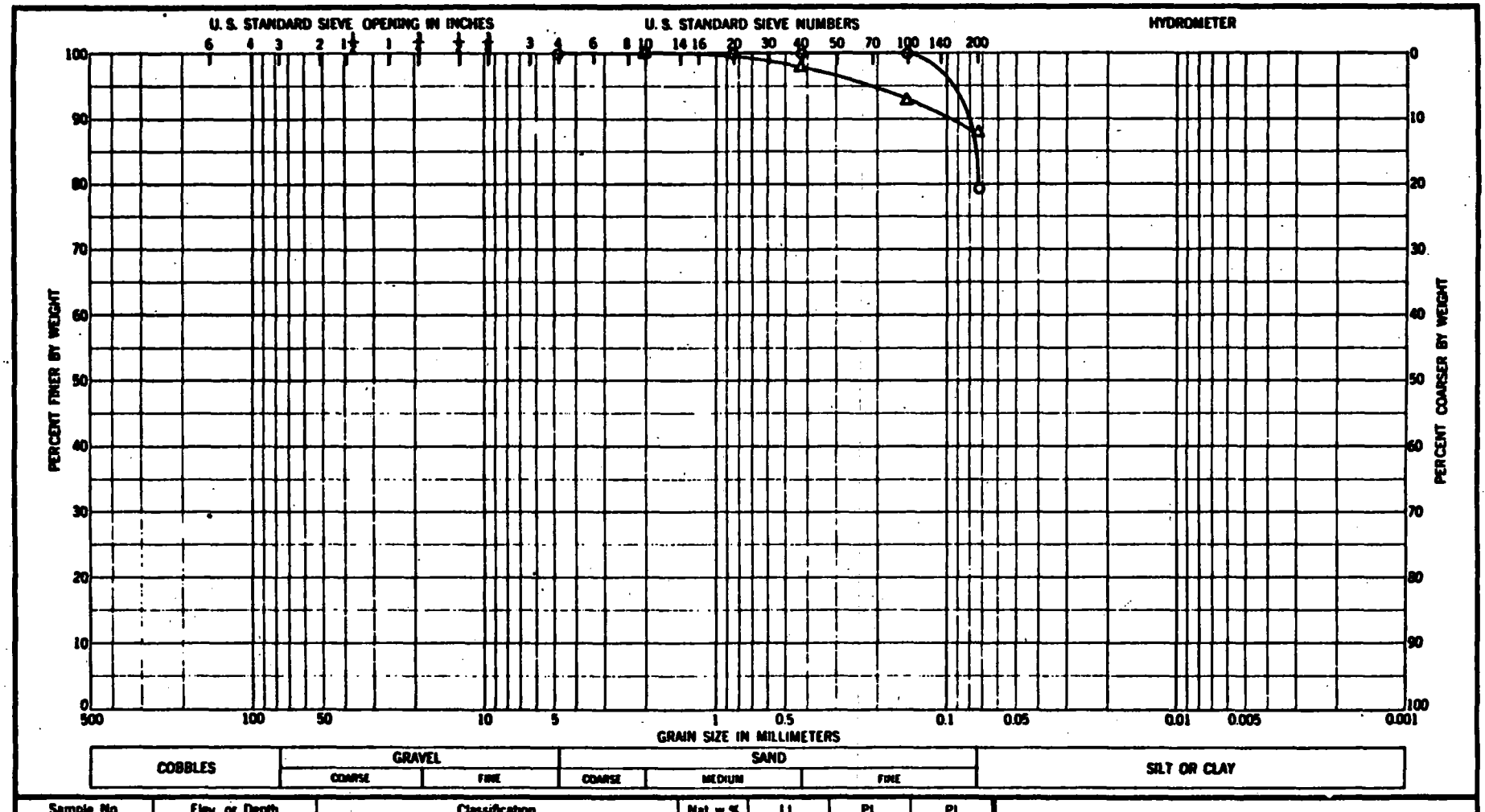
Boring No. 20A-8

Date October 83

SWDED-GL Report No. 13657-1a

Plate 3

ENG FORM 1 MAY 63 2087



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
83/3904 o	3.4-6.4	SILT, sandy (ML)	12.7	NP	NP	NP
83/3910 Δ	22.4-25.8	CLAY (CL)	32.8	37	18	19

GRADATION CURVES

Project Pine Bluff Arsenal

Area

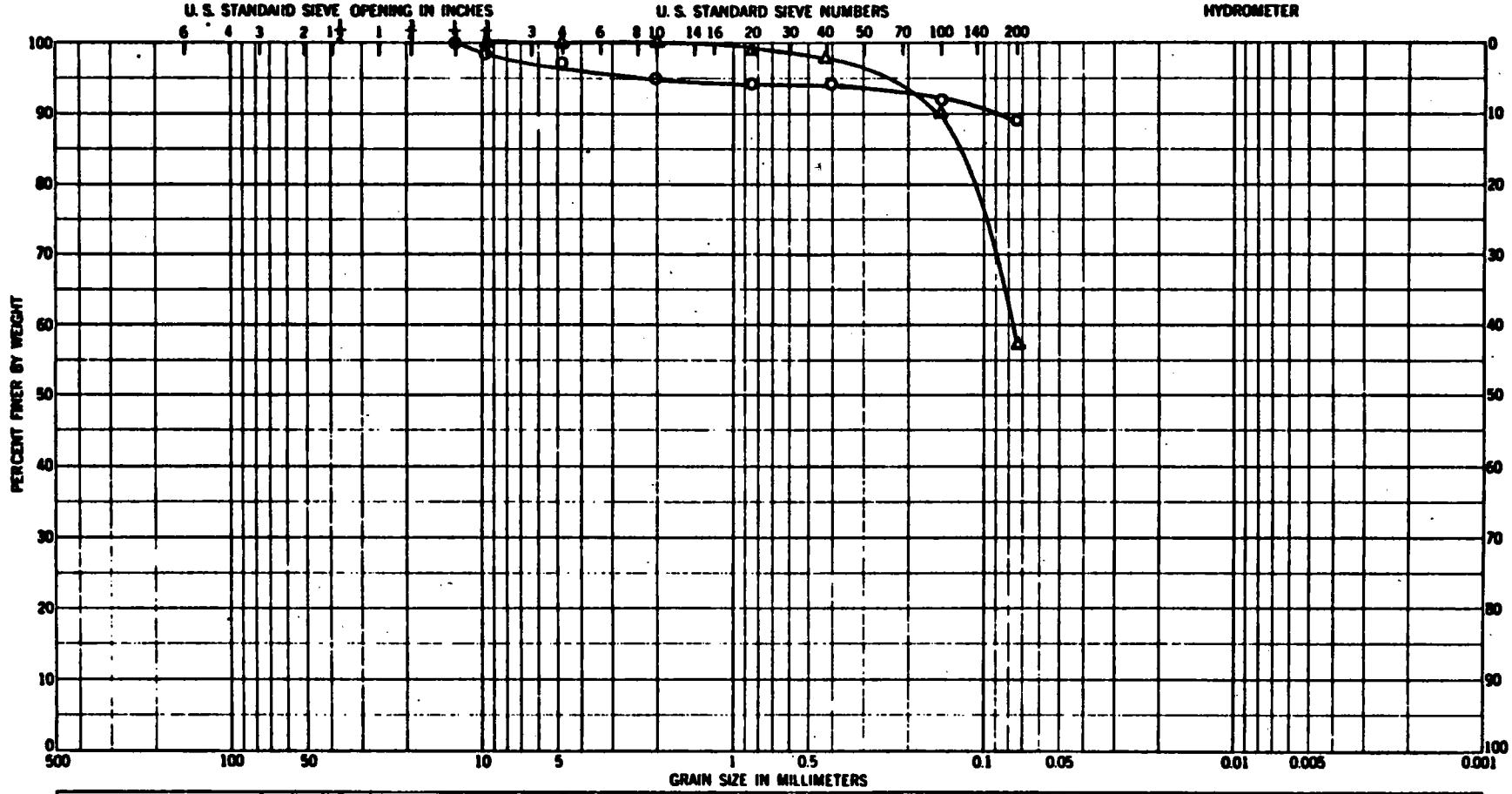
Boring No. 20A-9

Date October 83

Plate 4

SWDED-GL Report No. 13657-1a

ENG FORM 1 MAY 63 2087



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
83/3916 o	0.0-2.8	CLAY (CL)	23.9	36	21	15
83/3923 Δ	18.8-21.8	SILT, sandy (ML)	25.5	20	18	2

GRADATION CURVES

Project: Pine Bluff Arsenal

Area:

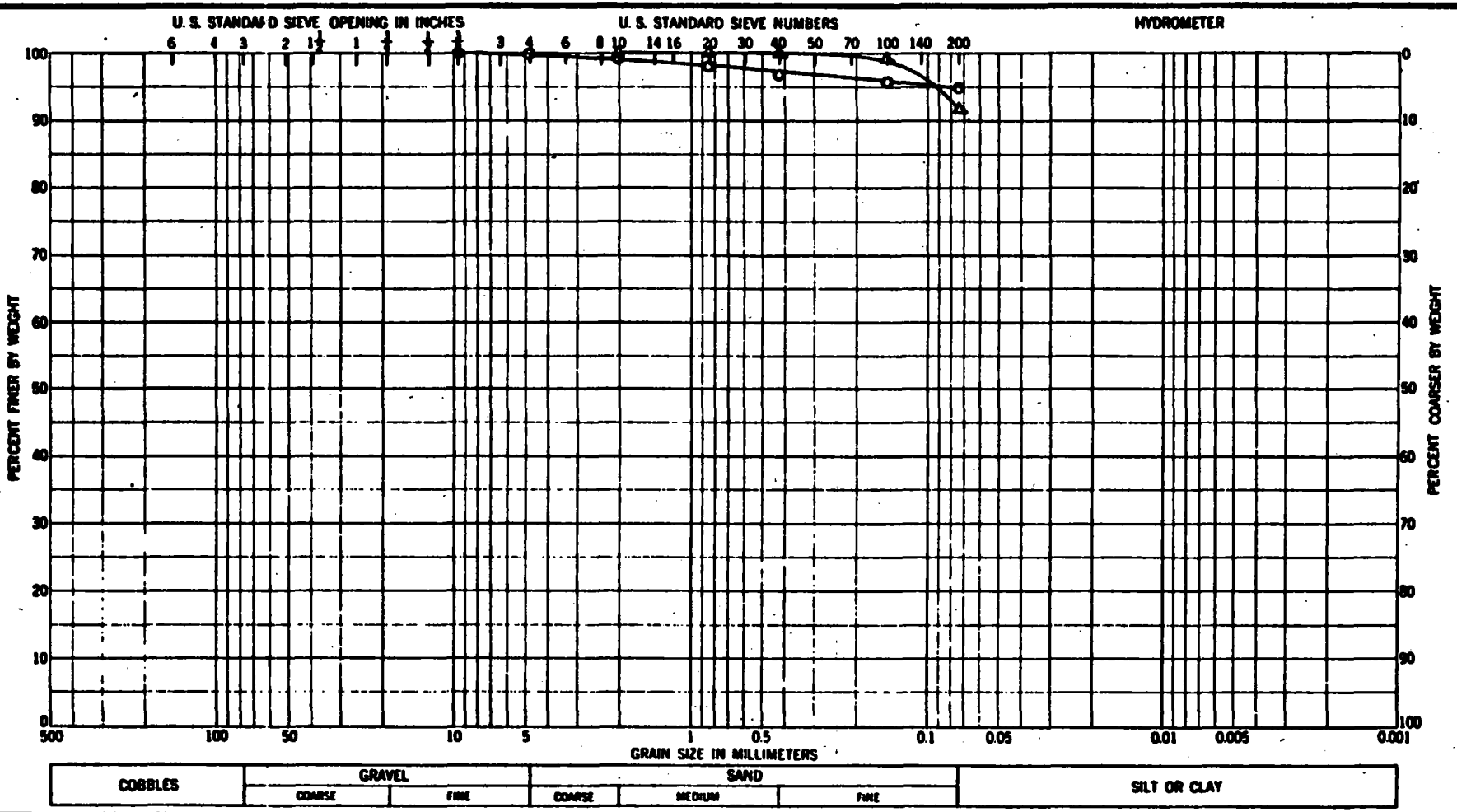
Boring No.: 20A-10

Date: October 83

Plate 5

SWDED-GL Report No .13657-1a

ENG FORM 1 MAY 63 2087



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
83/3932 o	4.8-7.8	CLAY (CL)	38.4	34	19	15
83/3936 Δ	16.8-20.0	CLAY (CL)	29.0	33	17	16

GRADATION CURVES

Project Pine Bluff Arsenal

Area

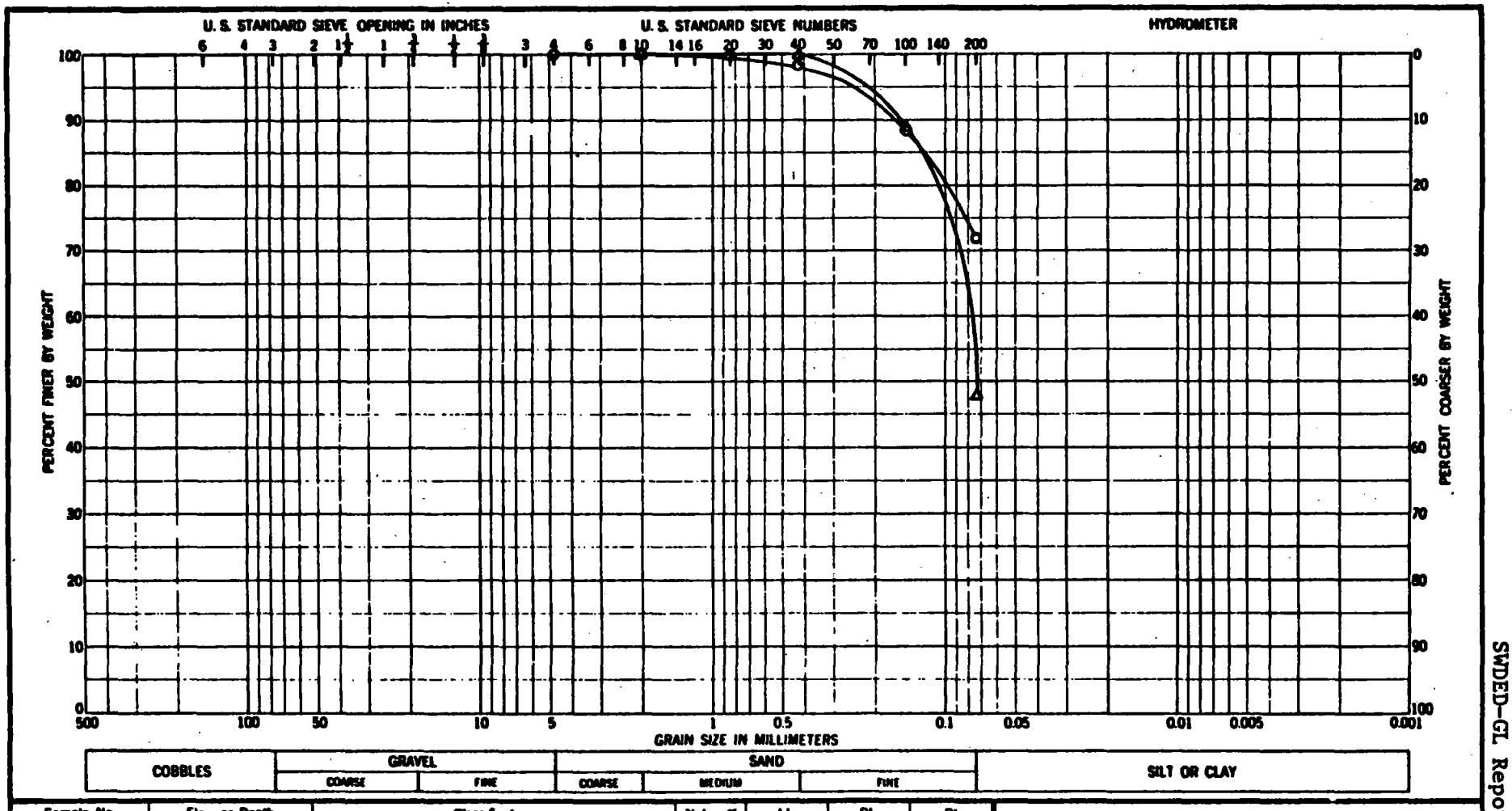
Boring No. 20A-11

Date October 83

Plate 6

SWDED-GL Report No. 13657-1a

ENG FORM 1 MAY 63 2087



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
83/3945 ○	3.0-6.5	CLAY, sandy (CL)	16.9	29	15	14
83/3950 △	19.0-21.5	SAND, silty (SM)	20.6	NP	NP	NP

GRADATION CURVES

Project Pine Bluff Arsenal

Area

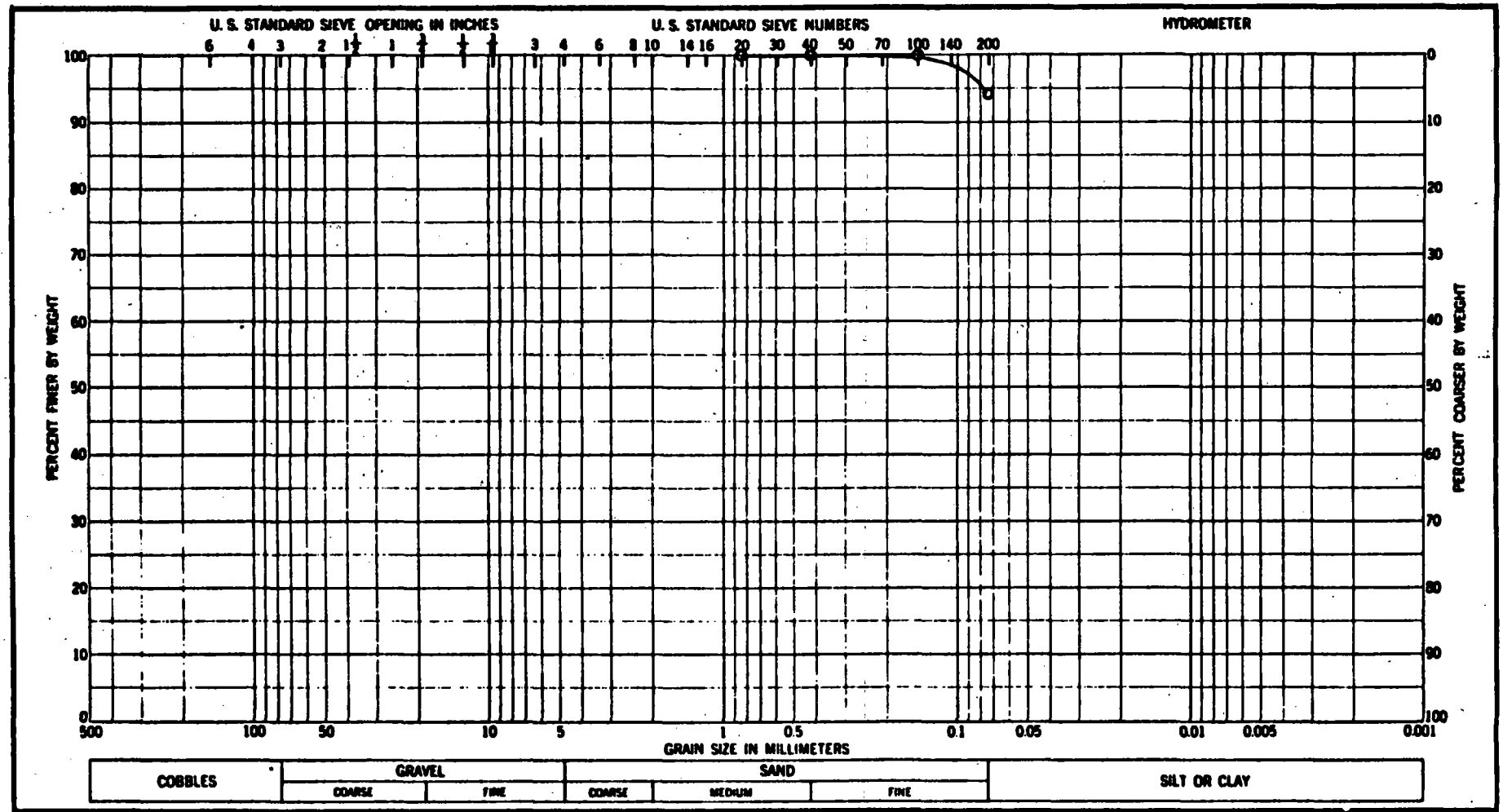
Boring No. 20A-12

Date October 83

Plate 7

SWDED-GL Report No. 13657-1a

ENG FORM 1 MAY 63 2087



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
83/3985 o	7.0-10.5	SILT (ML)	27.5	23	21	2

Project: Pine Bluff Arsenal

Area:

Boring No.: 20A-13

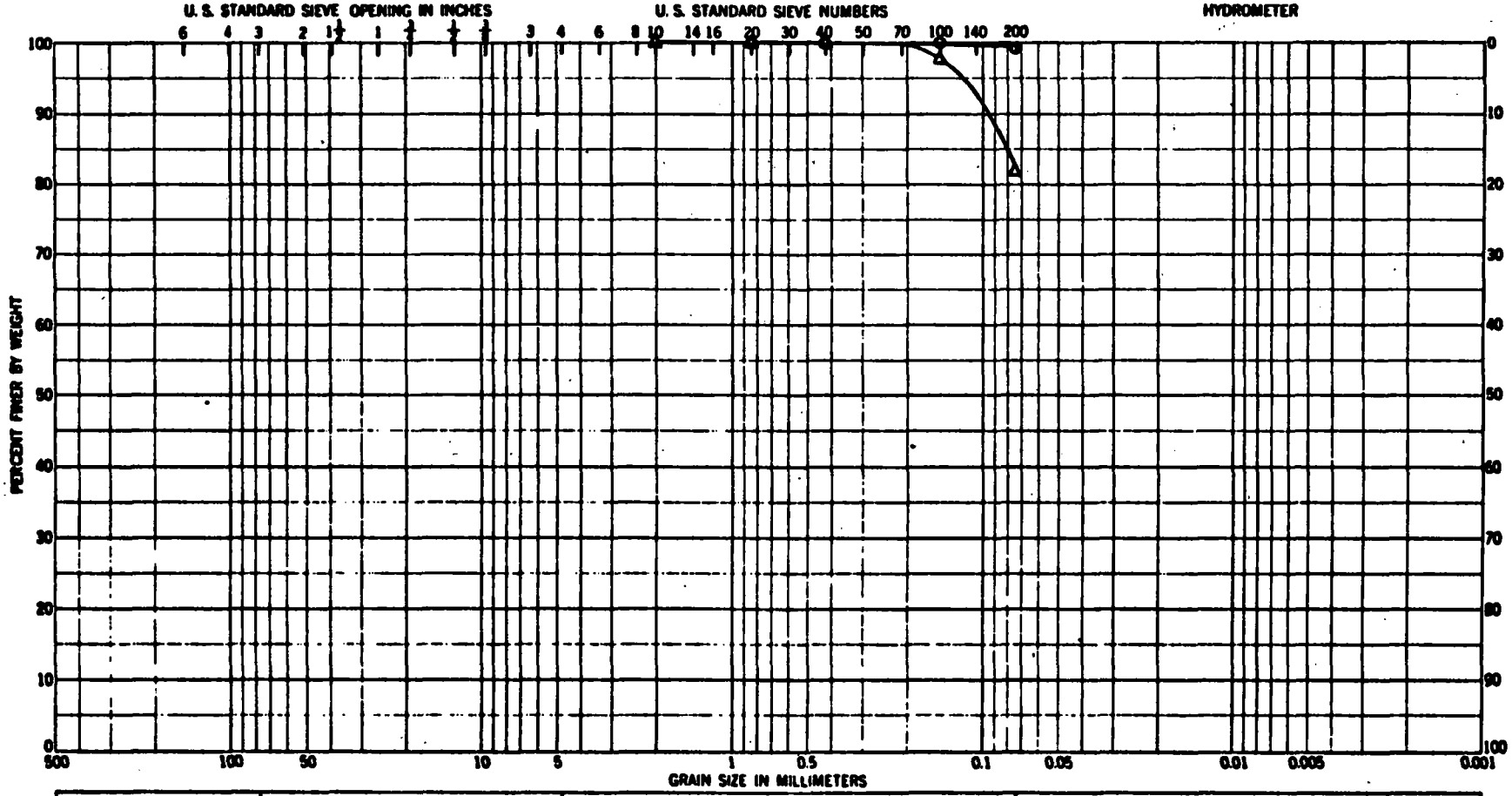
Date: October 83

GRADATION CURVES

Plate 8

ENG FORM 1 MAY 63 2087

SWDED-GL Report No. 13657-1a



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
83/3998 ○	4.8-7.8	CLAY (CL)	25.9	49	19	30
83/4001 △	13.0-16.0	SILT (ML-CL)	26.8	23	19	4

GRADATION CURVES

Project: Pine Bluff Arsenal

Area:

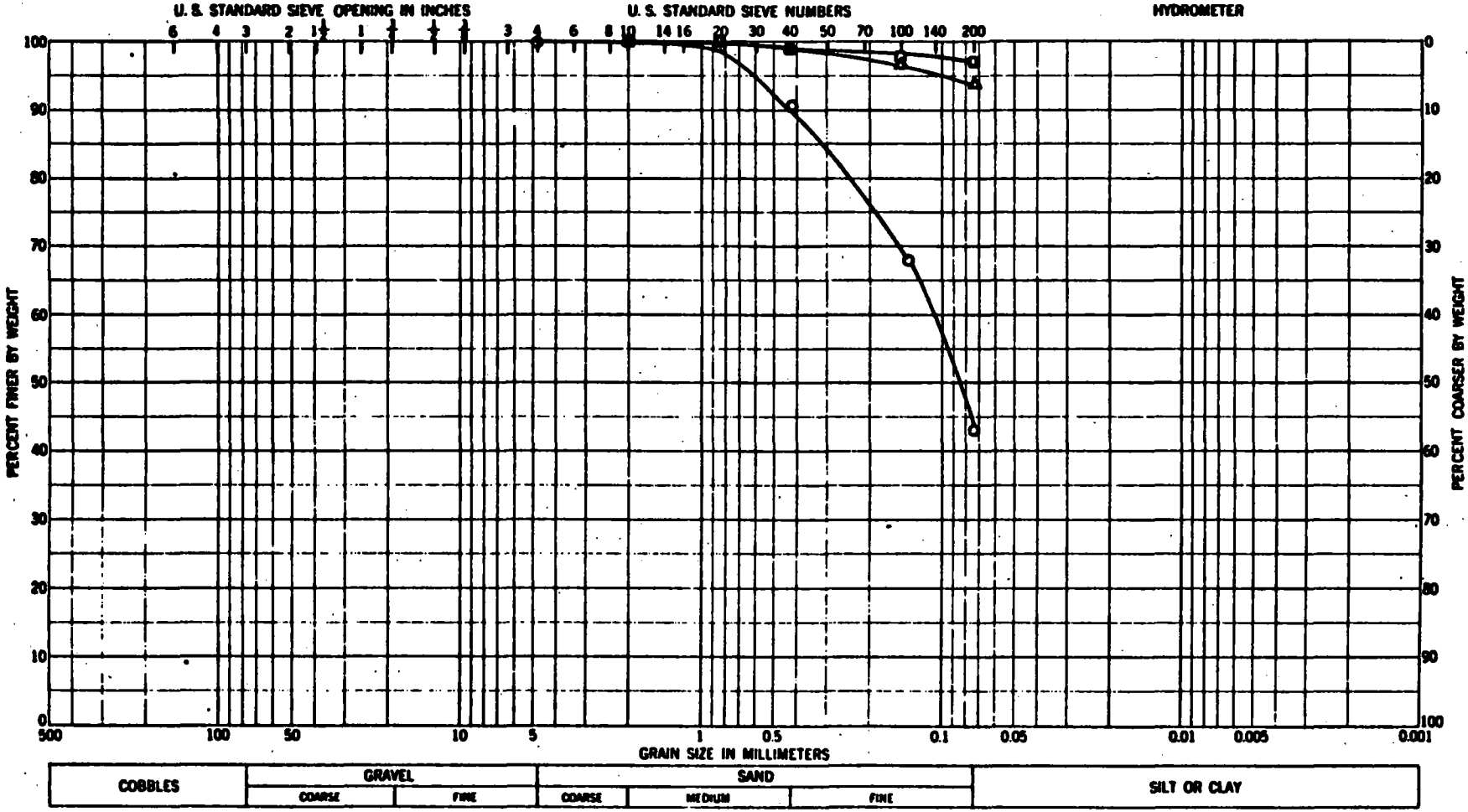
Boring No.: 20A-14

Date: October 83

Plate 9

SWDED-GL Report No. 13657-1a

ENG FORM 1 MAY 63 2087



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
83/3958 ○	0.1-1.0	SAND,silty (SM)	6.8	NP	NP	NP
83/3963 △	3.0-6.0	CLAY (CL)	34.9	40	19	21
83/3965 □	9.0-10.5	CLAY (CL)	36.2	41	19	22

GRADATION CURVES

Project: Pine Bluff Arsenal

Area:

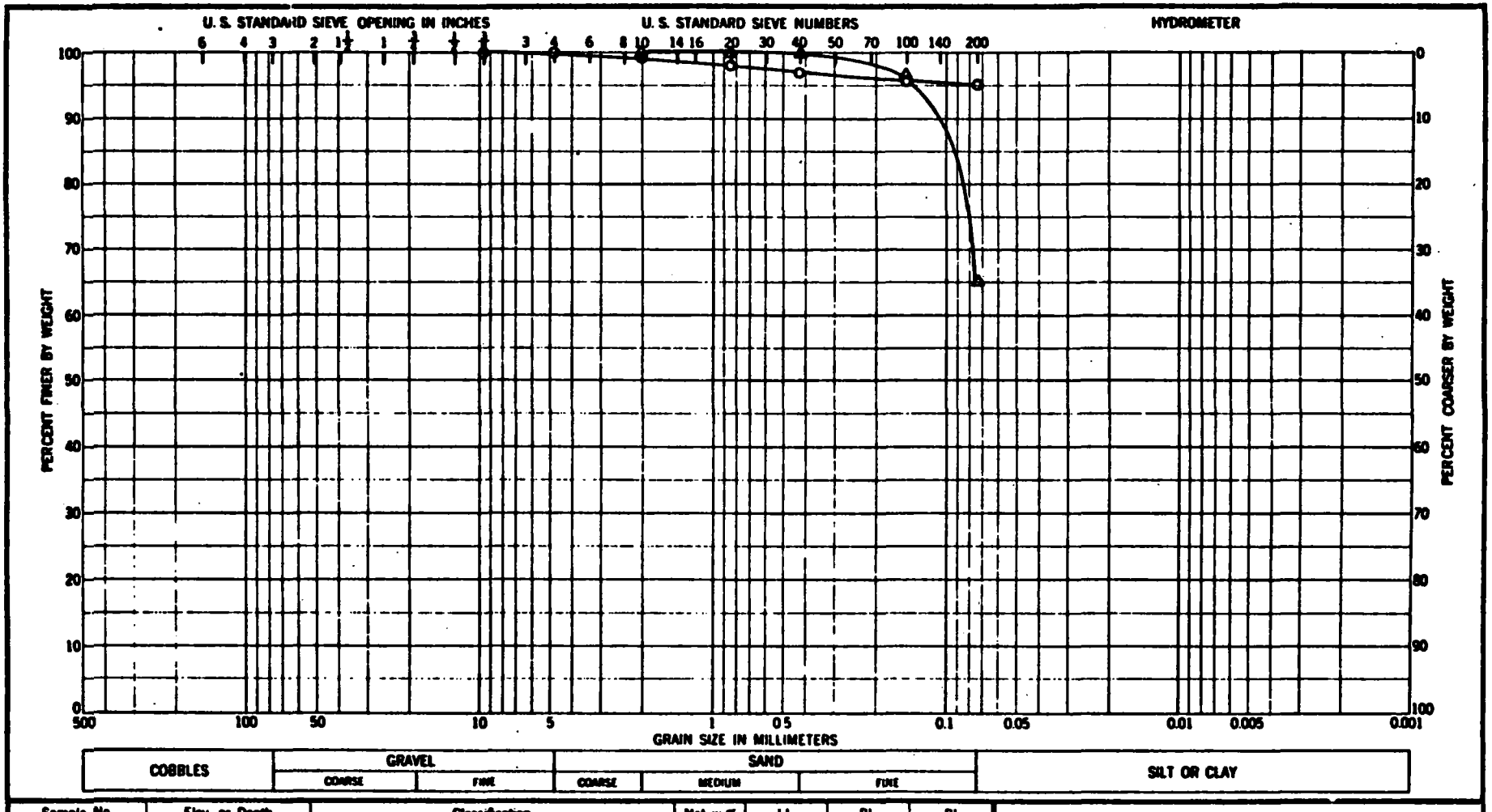
Boring No. 20A-15

Date: October 83

Plate 10

SWDED-GL Report No. 13657-1a

ENG FORM 1 MAY 63 2087



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
83/3973 o	2.0-3.0	CLAY (CH)	33.2	64	23	41
83/3977 Δ	10.5-13.5	SILT,sandy (ML)	24.3	NP	NP	NP

GRADATION CURVES

Project Pine Bluff Arsenal

Area

Boring No. 20A-16

Date October 83

Plate 11

SWDED-GL Report No. 13657-1a

ENG FORM 1 MAY 83 2087

SWD LABORATORY REPORT 13657-2

Table 1

Pine Bluff Arsenal
Site 20A

Results of Chemical Analyses of Soil - Total Ions(1)

Hole No.	Field No.	SWD No. G-	Depth ft	Ag	As	Ba	Cd	Cr	Hg	Pb	Se	Zn	Total Phosphates
13	1	3982	0.0- 1.5							11.9		130.2	
	2	83	1.5- 4.5							< 1.0		57.7	
	3	84	4.5- 7.0							< 1.0		12.8	
	4	85	7.0-10.5							< 1.0		21.0	
	5	86	10.5-12.5							< 1.0		7.9	
	6	87	12.5-16.0							1.0		10.0	
	7	88	16.0-19.0							4.8		7.9	
	8	89	19.0-22.0										
	9	90	22.0-25.0										
	10	91	25.0-28.0										
	11	92	28.0-31.0										
	12	93	31.0-34.0										
	13	94	34.0-37.0										
	14	95	37.0-40.1										
14	1	3996	0.0- 3.8							2.5		53.9	
	2	97	3.8- 4.8							3.1		22.4	
	3	98	4.8- 7.8							3.1		15.4	
	4	99	7.8-10.0							< 1.0		29.6	
	5	4000	10.0-13.0							< 1.0		14.1	
	6	01	13.0-16.0							10.0		97.0	
	7	02	16.0-19.0							1.0		16.0	
	8	03	19.0-22.0										
	9	04	22.0-25.0										
	10	05	25.0-28.0										
	11	06	28.0-31.0										
	12	07	31.0-34.0										
	13	08	34.0-37.0										
	14	09	37.0-40.0										

(1) All results are in mg/kg.

Table 1 (Cont'd)

Results of Chemical Analyses of Soil - Total Ions(1)

Hole No.	Field No.	SWD No. G-	Depth ft	Ag	As	Ba	Cd	Cr	Hg	Pb	Se	Zn	Total Phosphates
17	1	4010	0.0- 0.8							65.1		121.5	
	2	11	0.8- 1.0							< 1.0		36.8	
	3	12	1.0- 2.0							4.7		19.8	
	4	13	2.0- 3.0							3.8		15.7	
	5	14	3.0- 5.0							7.2		39.2	
	6	15	5.0- 6.0							< 1.0		17.2	
	7	16	6.0- 9.0							< 1.0		20.3	
	8	17	9.0-10.5										
	9	18	10.5-12.0										
	10	19	12.0-15.0										
	11	20	15.0-18.0										
	12	21	18.0-21.0										
	13	22	21.0-22.5										
	14	23	22.5-24.0										
	15	24	24.0-27.0										
	16	25	27.0-30.0										
	17	26	30.0-33.0										
	18	27	33.0-36.0										
	19	28	36.0-40.0										
18	1	4029	0.0- 1.0							8.8		98.2	
	2	30	1.0- 2.0							6.9		111.1	
	3	31	2.0- 3.0							36.8		158.4	
	4	32	3.0- 3.5							253.3		177.8	
	5	33	3.5- 9.0							2.1		98.7	
	6	34	9.0-12.0							2.9		183.7	
	7	35	12.0-15.0										
	8	36	15.0-22.5										
	9	37	22.5-23.5										

(1) All results are in mg/kg.

Results of Chemical Analyses of Soil - Total Ions(1)

Hole No.	Field No.	SWD No. G-	Depth ft	Ag	As	Ba	Cd	Cr	Hg	Pb	Se	Zn	Total Phosphates
18	10	4038	23.5-27.0										
	11	39	27.0-30.0										
	12	40	33.0-36.0										
	13	41	36.0-40.0										
19	1	4042	0.0- 1.1							6.1		11.7	
	2	43	1.1- 2.0							3.0		61.7	
	3	44	2.0- 3.0							6.9		39.0	
	4	45	3.0- 6.0							5.3		23.9	
	5	46	6.0- 7.5							5.2		41.2	
	6	47	7.5-10.5							1.0		31.8	
	7	48	10.5-13.0										
	8	49	13.0-16.5										
	9	50	16.5-19.5										
	10	51	19.5-22.5										
	11	52	22.5-25.5										
	12	53	25.5-28.5										
	13	54	28.5-31.5										
	14	55	31.5-34.5										
	15	56	34.5-37.5										
	16	57	37.5-40.0										
20	1	4058	0.0- 0.4							8.1		2.7	
	2	59	0.4- 1.0							11.5		126.1	
	3	60	1.0- 2.0							15.7		130.1	
	4	61	2.0- 3.0										
	5	62	3.0- 6.0										
	6	63	6.0- 9.0										
	7	64	9.0-12.0										
	8	65	12.0-15.0										

(1) All results are in mg/kg.

Table 1 (Cont'd)

Results of Chemical Analyses of Soil - Total Ions(1)

Hole No.	Field No.	SWD No. G-	Depth ft	Ag	As	Ba	Cd	Cr	Hg	Pb	Se	Zn	Total Phosphates
20	9	4066	15.0-18.0										
	10	67	18.0-21.0										
	11	68	21.0-24.5										
	12	69	24.5-28.0										
	13	70	28.0-31.0										
	14	71	31.0-34.0										
	15	72	34.0-37.0										
	16	73	37.0-39.9										
21	1	4074	0.0- 0.2										
	2	75	0.2- 1.0										
	3	76	1.0- 2.0										
	4	77	2.0- 3.0										
	5	78	3.0- 6.0										
	6	79	6.0- 9.5										
	7	80	9.5-12.5										
	8	81	12.5-15.5										
	9	82	15.5-17.5										
	10	83	17.5-21.0										
	11	84	21.0-24.0										
	12	85	24.0-27.0										
	13	86	27.0-30.5										
	14	87	30.5-33.5										
	15	88	33.5-37.0										
	16	89	37.0-40.0										
22	1	4090	0.0- 0.5							551.7		1011.5	
	2	91	0.5- 1.0							15.9		42.9	
	3	92	1.0- 2.0							11.4		36.4	

(1) All results are in mg/kg.

Table 1 (Cont'd)

Pine Bluff Arsenal
Site 20A

Results of Chemical Analyses of Soil - Total Ions[1]

Hole No.	Field No.	SWD No. G-	Depth ft	Ag	As	Ba	Cd	Cr	Hg	Pb	Se	Zn	Total Phosphates
22	4	4093	2.0- 3.0							23.3		64.8	
	5	94	3.0- 6.0							12.2		29.9	
	6	95	6.0- 9.0							6.3		27.1	
	7	96	9.0-12.0							10.0		31.4	
	8	97	12.0-15.0							5.7		18.2	
	9	98	15.0-18.0										
	10	99	18.0-21.0										
	11	4100	21.0-24.0										
	12	01	24.0-27.0										
	13	02	27.0-30.0										
	14	03	30.0-33.0										
	15	04	33.0-36.0										
	16	05	36.0-39.6										
23	1	4106	0.0- 1.0										
	2	07	1.0- 2.0										
	3	08	2.0- 3.0										
	4	09	3.0- 6.0										
	5	10	6.0- 9.5										
	6	11	9.5-12.5							12.7		117.6	
	7	12	12.5-15.5							13.4		81.9	
	8	13	15.5-17.0							4.6		61.3	
	9	14	17.0-20.0							8.5		70.3	
	10	15	20.0-23.0										
	11	16	23.0-26.0										
	12	17	26.0-29.0										
	13	18	29.0-31.5										
	14	19	31.5-34.0										
	15	20	34.0-37.0										
	16	21	37.0-39.8										

(1) All results are in mg/kg.

Table 1 (Cont'd)

Results of Chemical Analyses of Soil - Total Ions(1)

Hole No.	Field No.	SWD No. G-	Depth ft	Ag	As	Ba	Cd	Cr	Hg	Pb	Se	Zn	Total Phosphates
24	1	4122	0.0- 1.0										
	2	23	1.0- 2.0										
	3	24	2.0- 3.0										
	4	25	3.0- 6.5										
	5	26	6.5- 9.5										
	6	27	9.5-12.5										
	7	28	12.5-15.5										
	8	29	15.5-18.5										
	9	30	18.5-21.5										
	10	31	21.5-24.6										
	11	32	24.6-27.5										
	12	33	27.5-30.5										
	13	34	30.5-33.5										
	14	35	33.5-36.5										
	15	36	36.5-40.0										
"Sediment"*													
-	SD-4	4395	-			217.4				38.3		132.5	
-	SD-5	96	-			47.8				4.3		1665.2	
-	SD-6	97	-			135.4				3.7		261.5	
-	SD-7	98	-			115.8				5.6		191.5	
-	SD-8	99	-			94.4				9.8		562.3	
-	SD-9	4400	-			113.6				35.4		504.5	
-	SD-10	01	-			38.2				31.2		861.8	
-	SD-11	02	-			71.4				3.6		371.4	
"Soil"*													
-	S-1	4393	0.3- 1.0			147.4				8.9		100.1	
-	S-2	94	0.3- 1.0			158.7				14.6		228.6	

*As identified in Test Request. "Sediment" jars were labeled Lagoon Sediment.
(1) All results are in mg/kg.

Table 1 (Cont'd)

Pine Bluff Arsenal
Site 20A

Results of Chemical Analyses of Soil - Total Ions(1)

Hole No.	Field No.	SWD No. G-	Depth ft	Ag	As	Ba	Cd	Cr	Hg	Pb	Se	Zn	Total Phos-phates
"Lagoon Samples"*													
Trav 1	1	4153	Surface	<0.5	11.5	<20.0	2.5	10.0	0.2	60.0		507.5	927
	2	54	"										
	3	55	"										
	4	56	"										
	5	57	"										
	6	58	"										
	7	59	"										
	8	60	"							194.3		4571.4	
	9	61	"										
	10	62	"										
	11	63	"										
	12	64	"										
Trav 2	1	4165	Surface	0.5	14.1	147.1	11.8	10.6	0.4	107.1		364.1	1232
	2	67	"										
	3	69	"										
	4	71	"										
	5	73	"										
	6	75	"										
	7	77	"										
	8	79	"										
	9	81	"										
	10	83	"										
	11	85	"										
	12	87	"										
	13	89	"										
	14	91	"										
	15	93	"										
	16	95	"										
	17	97	"										

(1) All results are mg/kg.

Table 1 (Cont'd)

Pine Bluff Arsenal
Site 20A

Results of Chemical Analyses of Soil - Total Ions(1)

Hole No.	Field No.	SWD No. G-	Depth ft	Ag	As	Ba	Cd	Cr	Hg	Pb	Se	Zn	Total Phosphates
Trav 2	18	4199	Surface										
	19	4201	"										
	20	03	"										
	21	05	"										
	22	07	Unmarked										
	23	09	"										
Trav 2	1	4166	Bottom	<0.5	8.5	112.7	0.5	<5.0	0.1	4.5		91.3	601
	2	68	"										
	3	70	"			111.9				11.3		66.4	
	4	72	"										
	5	74	"			138.9				14.8		523.1	
	6	76	"			91.1				16.3		8.4	
	7	78	"										
	8	80	"										
	9	82	"			65.1				7.5		4.1	
	10	84	"										
	11	86	"										
	12	88	"			94.0				5.2		235.6	
	13	90	"										
	14	92	"										
	15	94	"			97.2				10.0		3966.7	
	16	96	"										
	17	98	"										
	18	4200	"			109.3				12.5		1278.7	
	19	02	"										
	20	04	"										
	20	04A	M			119.1	18.0	17.7		254.5		10836.4	
	21	06	Bottom			53.9				9.8		1354.8	

(1) All results are in mg/kg.

Table 1 (Cont'd)

Results of Chemical Analyses of Soil - Total Ions(1)

Hole No.	Field No.	SWD No. G-	Depth ft	Ag	As	Ba	Cd	Cr	Hg	Pb	Se	Zn	Total Phosphates
Trav 3	1	4211	Surface	<0.5	12.4	66.7	2.7	<5.0	0.1	40.0		614.7	1506
	2	13	"										
	3	15	"										
	4	17	"										
	5	19	"										
	6	21	"										

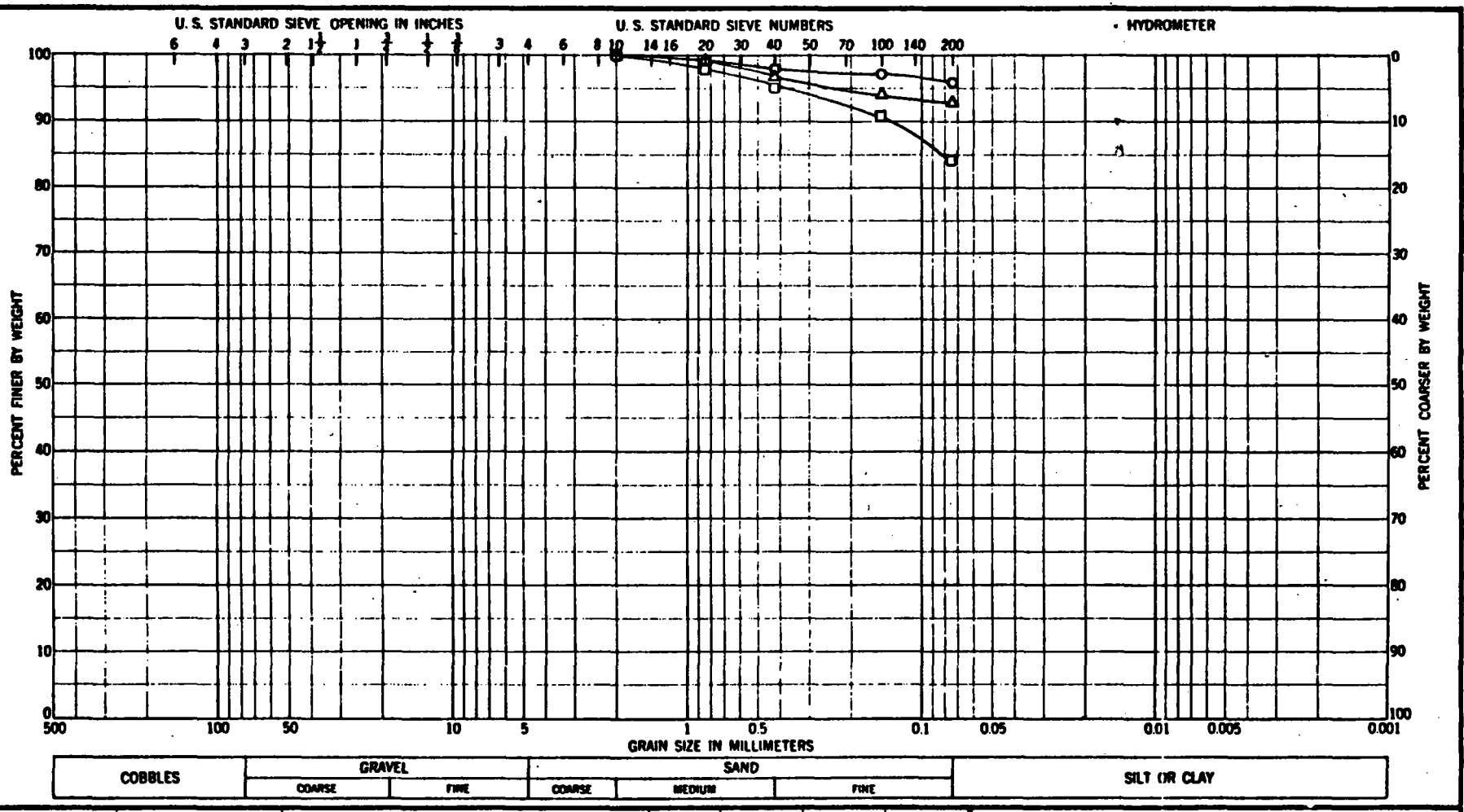
(1) All results are report in mg/kg.

Table 2

Results of Chemical Analyses of Soils - EP Toxicity(1)

Hole No.	Field No.	SWD No. G-	Depth ft	Ag	As	Ba	Cd	Hg	Pb	Se
11	2	3931	1.2- 4.8		0.03	1.2			0.03	

Results are reported in mg/l.



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
83/4014 ○	3.0-5.0	CLAY (CL)	29.0	44	20	24
83/4018 △	10.5-12.0	CLAY (CL)	30.9	43	19	24
83/4024 □	24.0-27.0	CLAY (CL)	36.2	48	19	29

GRADATION CURVES

Project Pine Bluff Arsenal

Area

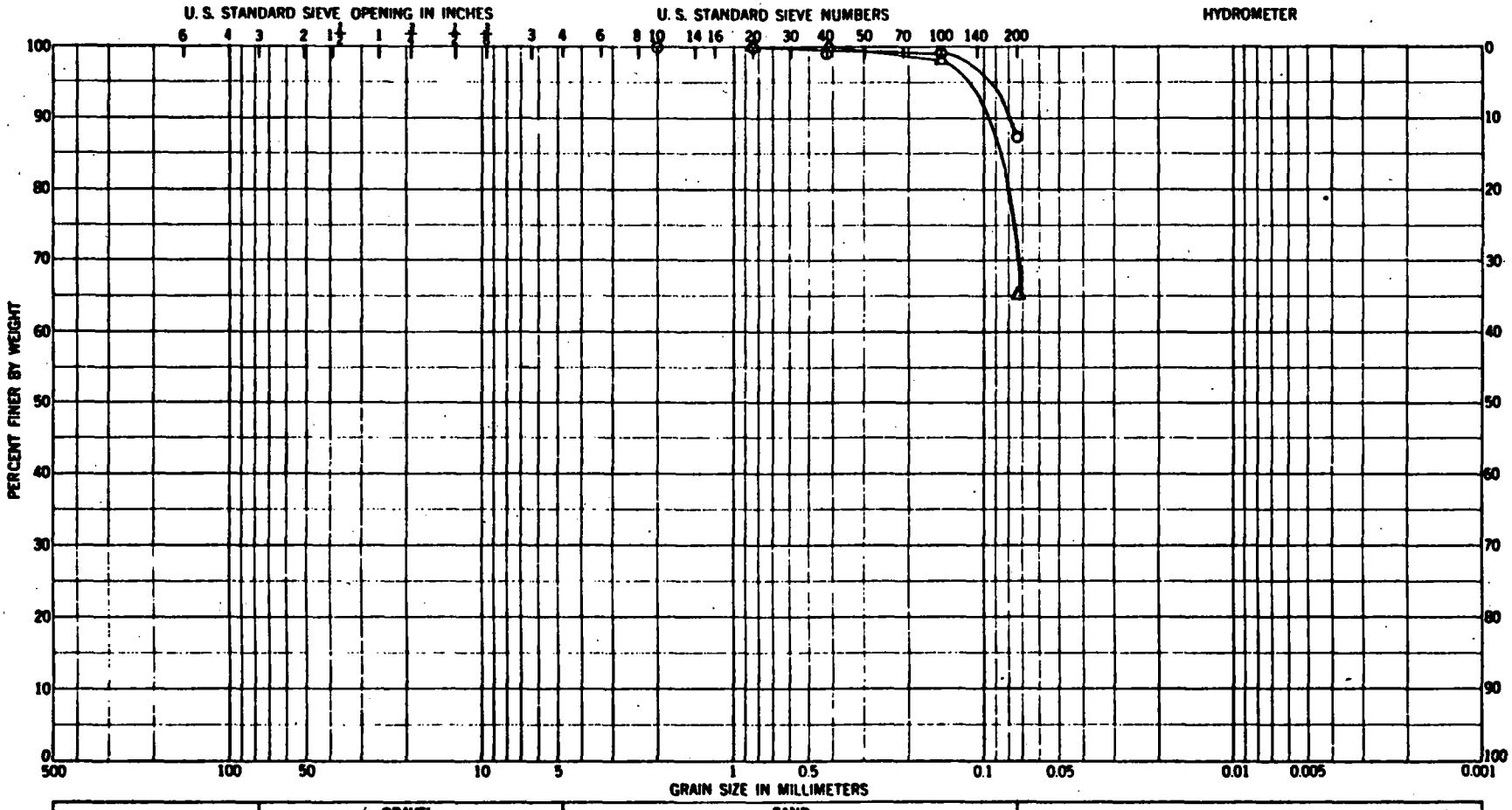
Boring No. 20A-17

Date Nov. 83

SWDED-GL Report No. 13657-2

Plate 1

ENG FORM 1 MAY 63 2087



Sample No.	Elev or Depth	Classification	Nat w,%	LL	PL	PI
83/4033 ○	3.5-9.0	SILT (ML)	26.4	NP	NP	NP
83/4036 △	15.0-22.5	SILT, sandy (ML)	24.0	NP	NP	NP

GRADATION CURVES

Project: Pine Bluff Arsenal

Area:

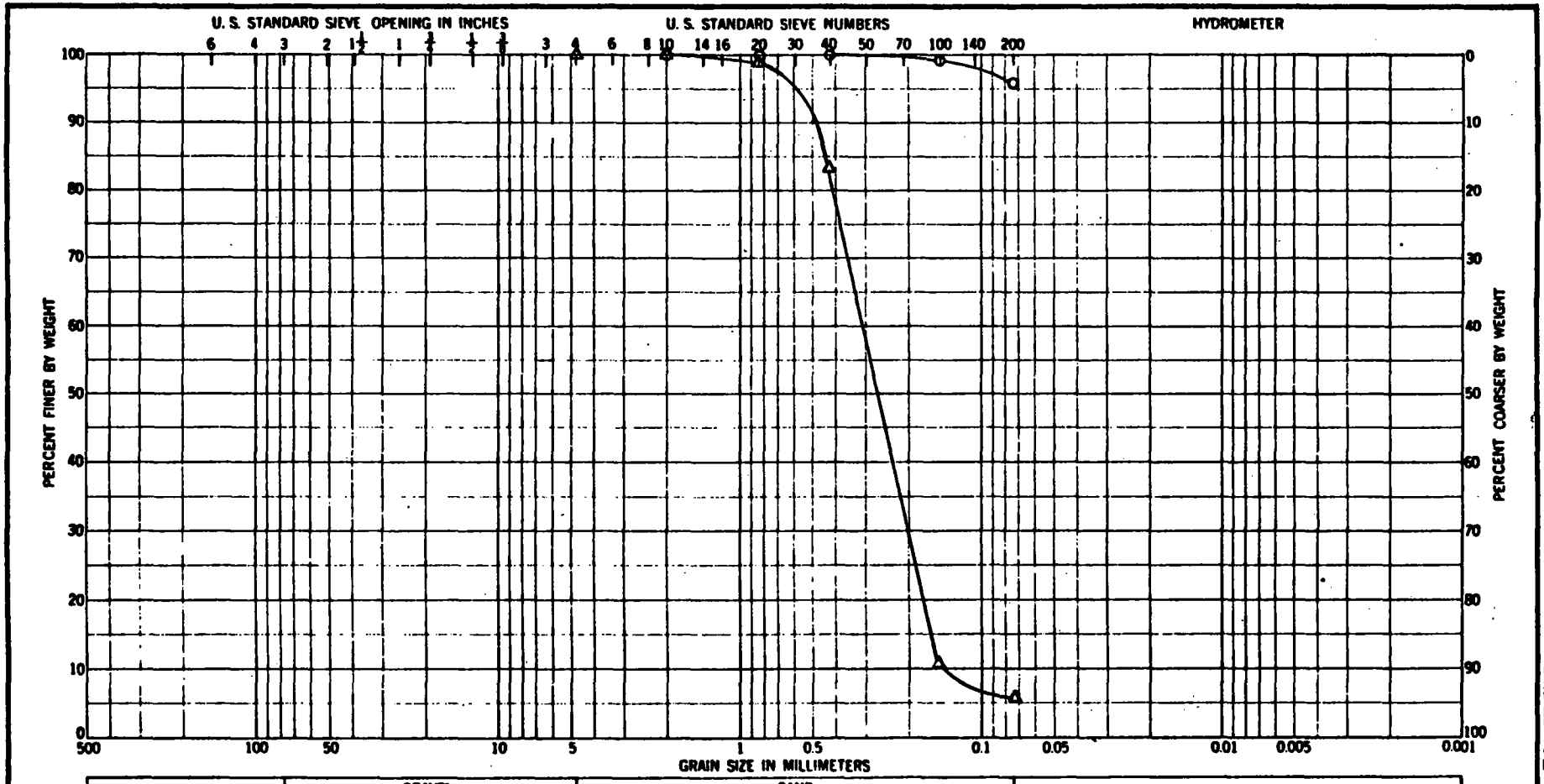
Boring No.: 20A-18

Date: Nov. 83

SWDED-GL Report No. 13657-2

Plate 2

ENG FORM 1 MAY 63 2087



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
83/4045 ○	3.0-6.0	CLAY (CL-ML)	21.7	26	19	7
83/4053 △	25.5-28.5	SAND(SP-SM)	21.7	NP	NP	NP

GRADATION CURVES

Project Pine Bluff Arsenal

Area

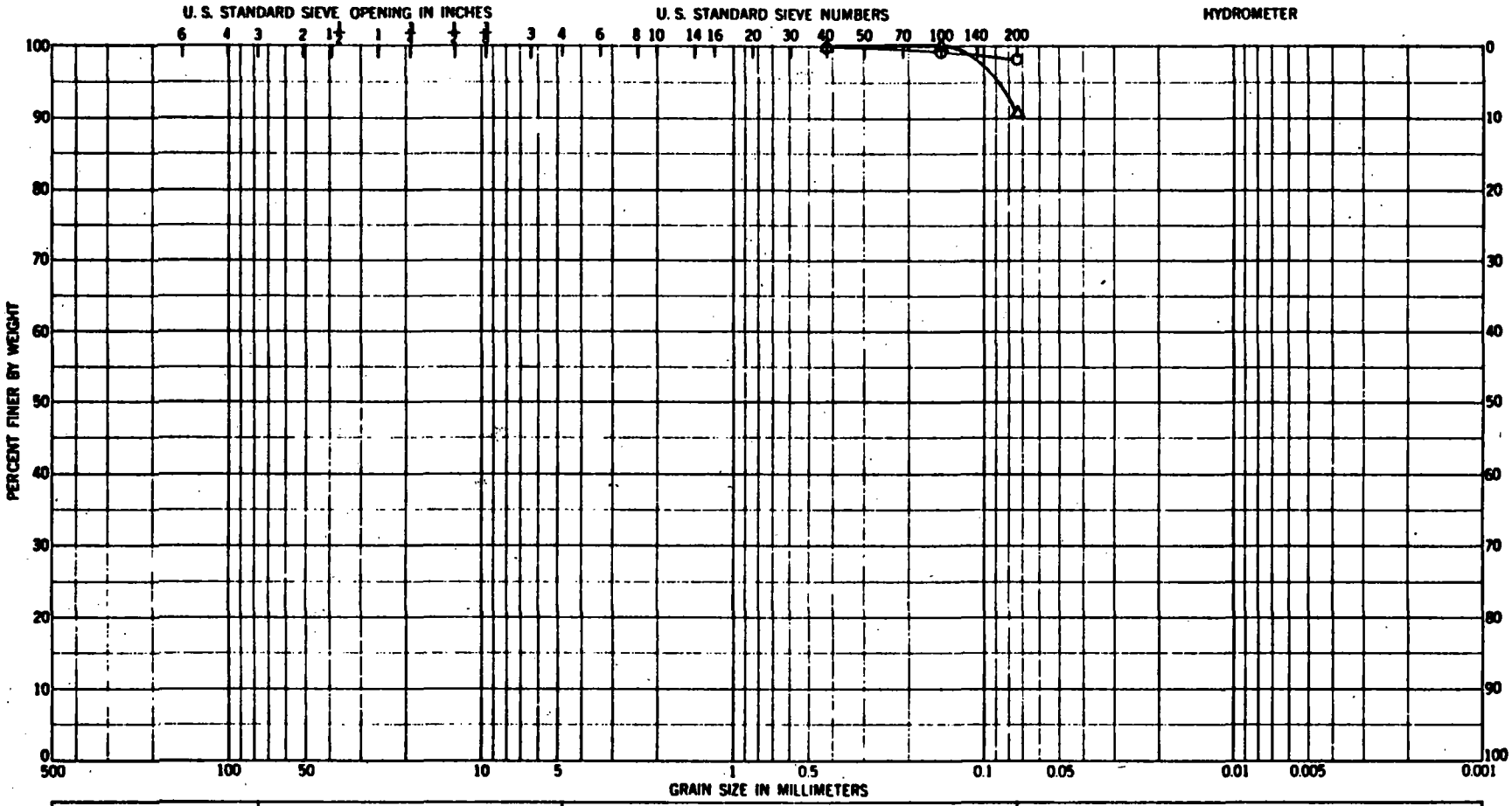
Boring No. 20A-19

Date Nov. 83

SWDED-GL Report No. 13657-2

Plate 3

ENG FORM 1 MAY 63 2087



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
83/4063 o	6.0-9.0	CLAY (CL-ML)	28.7	27	21	6
83/4069 Δ	24.5-28.0	CLAY (CL)	30.4	32	18	14

GRADATION CURVES

Project Pine Bluff Arsenal

Area

Boring No. 20A-20

Date Nov. 83

SWDED-GL Report No. 13657-2

Plate 4

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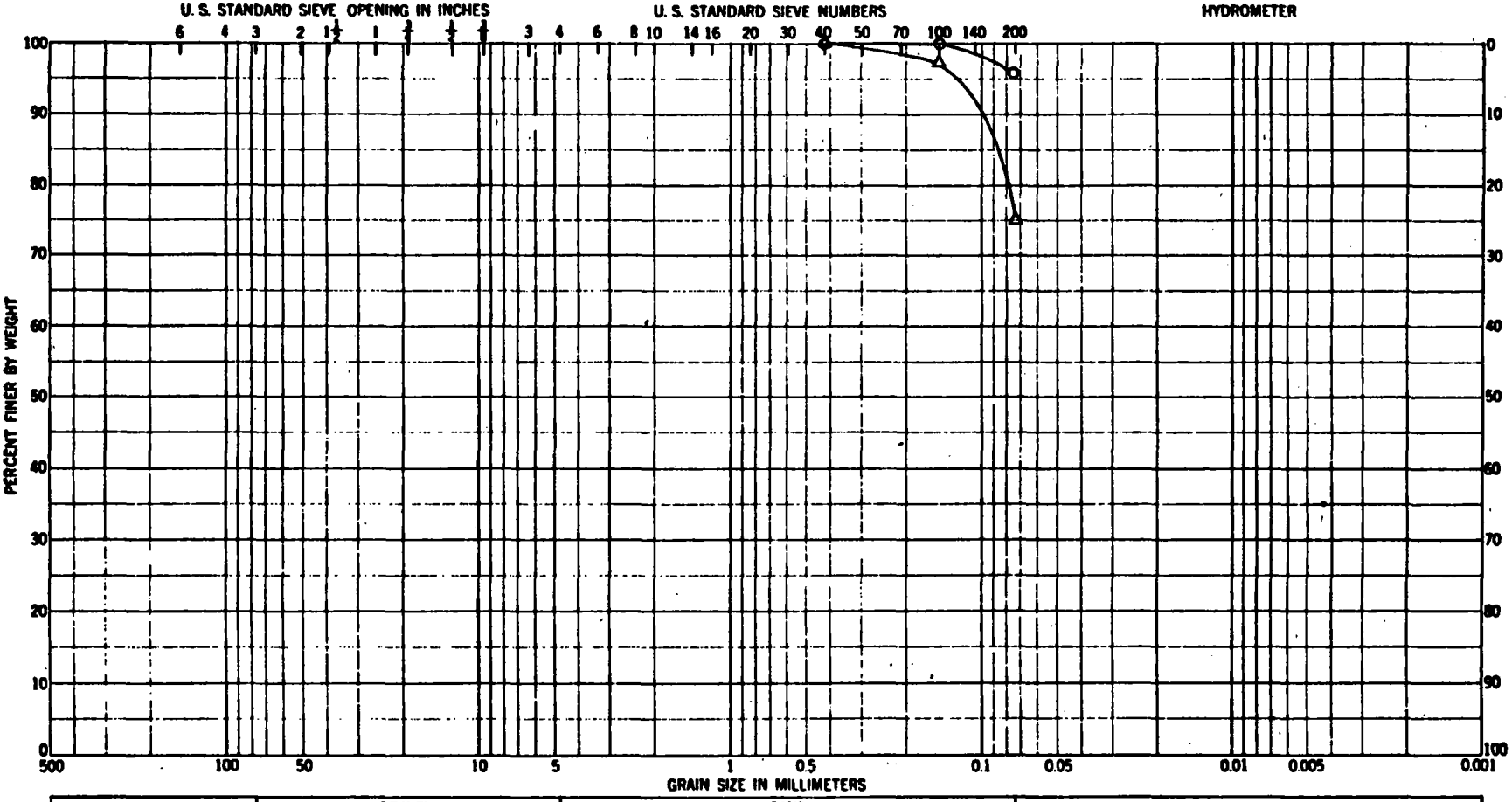


Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
83/4079 o	6.0-9.5	SILT (ML)	22.8	22	19	3
83/4083 Δ	17.5-21.0	CLAY, sandy (CL)	24.9	28	14	14

GRADATION CURVES

Project: Pine Bluff Arsenal

Area:

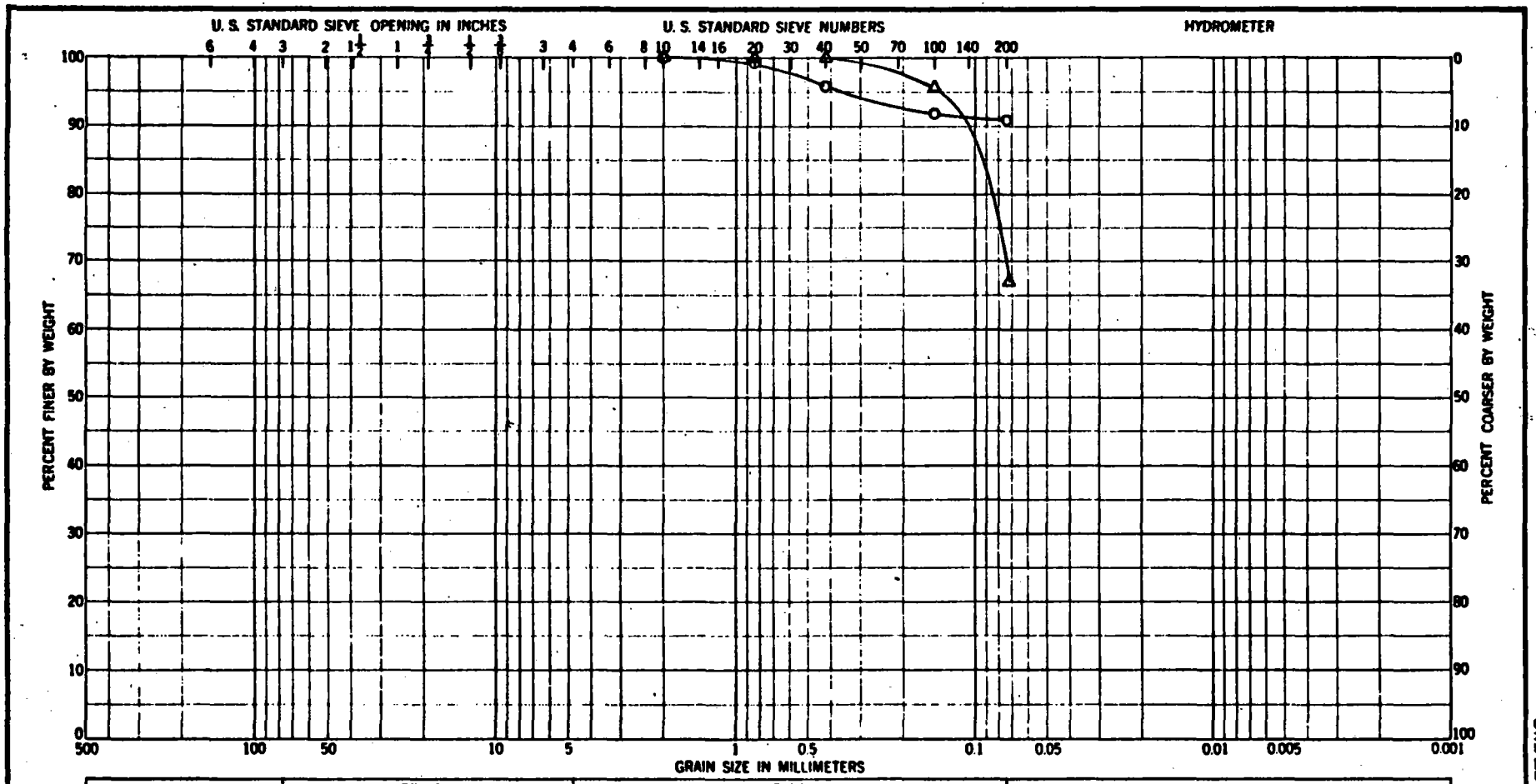
Boring No.: 20A-21

Date: Nov. 83

SWDED-GL Report No. 13657-2

Plate 5

ENG FORM 1 MAY 63 2087



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
83/4094 o	3.0-6.0	CLAY (CL)	27.0	38	18	20
83/4099 Δ	18.0-21.0	SILT, sandy (ML)	30.3	NP	NP	NP

GRADATION CURVES

Project: Pine Bluff Arsenal

Area:

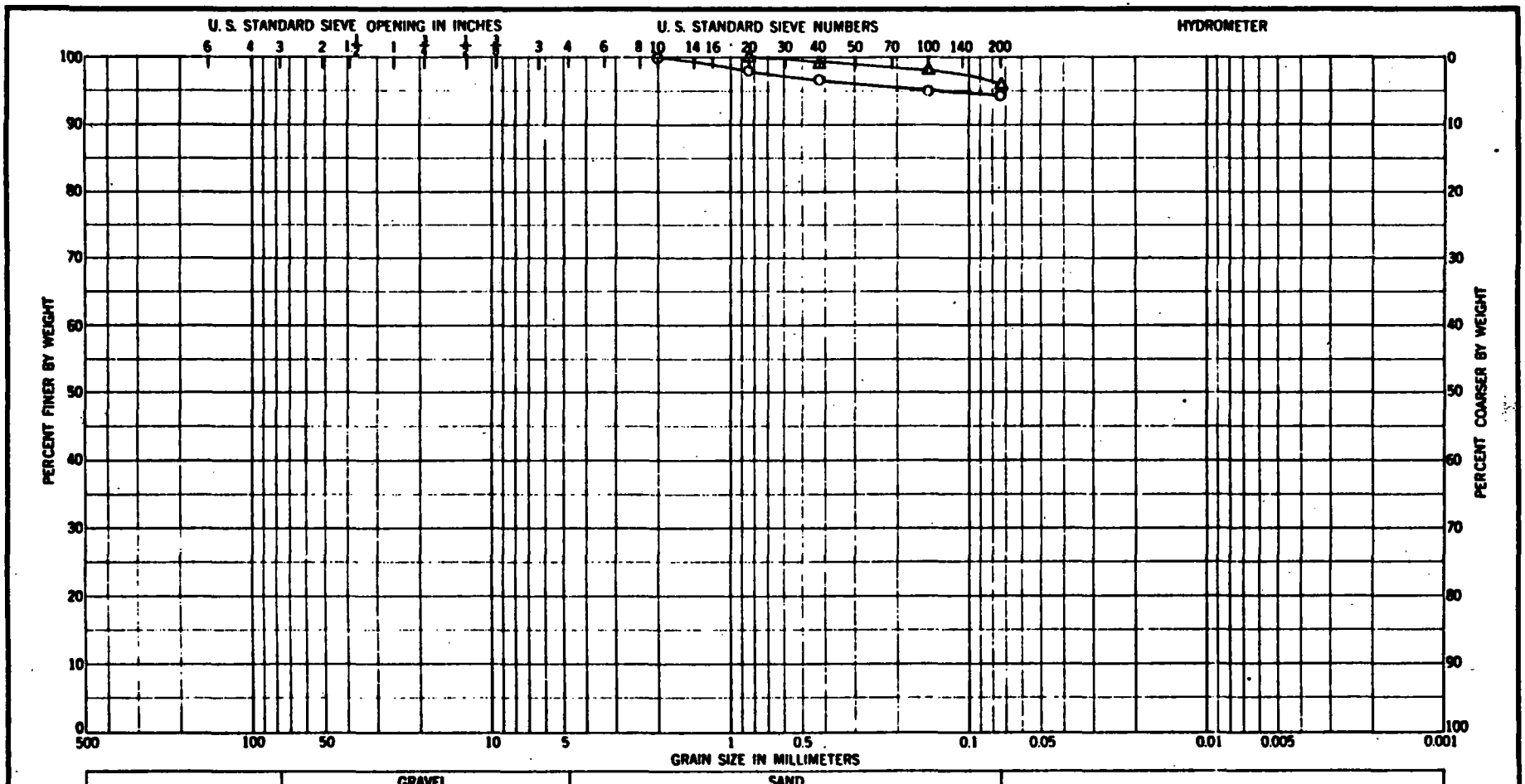
Boring No.: 20A-22

Date: Nov. 83

Plate 6

ENG FORM 1 MAY 63 2087

SWDED-GL Report No. 13657-2



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
83/4111 ○	9.5-12.5	CLAY (CL)	43.0	42	18	24
83/4116 △	23.0-26.0	CLAY (CL)	38.8	36	17	19

GRADATION CURVES

Project: Pine Bluff Arsenal

Area:

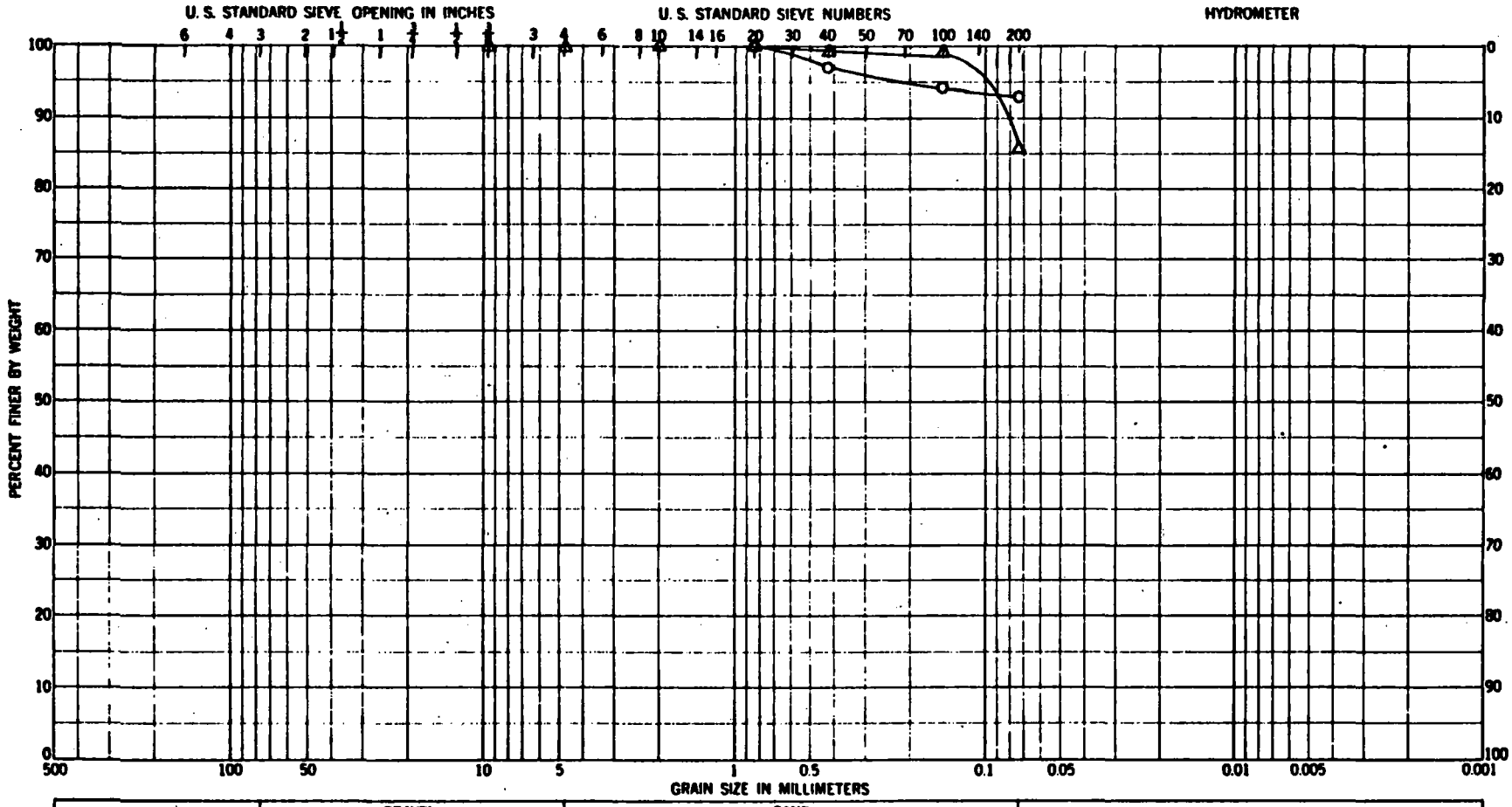
Boring No.: 20A-23

Date: Nov. 83

SWDED-GL Report No. 13657-2

Plate 7

ENG FORM 1 MAY 63 2087



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
83/4126 ○	6.5-9.5	CLAY (CH)	27.9	50	19	31
83/4128 △	12.5-15.5	SILT (ML)	29.4	23	20	3

GRADATION CURVES

Project: Pine Bluff Arsenal

Area:

Boring No.: 20A-24

Date: Nov. 83

SWDED-GL Report No. 13657-2

Plate 8

ENG FORM 1 MAY 63 2087

SWD LABORATORY REPORT 13657-2a

Results of Tests of Disturbed Soil Samples

Boring No.	Field No.	SWD No.	Depth ft.	Mechanical Analysis Gr	Sa	Fi	Atterberg Limits LL	PL	PI	LS	Water Content %		Description
20A-17	J-5	83/4014	3.0- 5.0	0	4	96	44	20	24		29.0	CL	CLAY
	J-7	83/4016	6.0- 9.0	-	-	-					28.2	CL	CLAY, brown, moist.
	J-9	83/4018	10.5-12.0	0	7	93	43	19	24		30.9	CL	CLAY
	J-11	83/4020	15.0-18.0	-	-	-					30.5	CL	CLAY, sandy, brown, moist.
	J-15	83/4024	24.0-27.0	0	16	84	48	19	29		36.2	CL	CLAY
20A-18	J-5	83/4033	3.5- 9.0	0	13	87	NP	NP	NP		26.4	ML	SILT
	J-7	83/4035	12.0-15.0	-	-	-					30.5	ML	SILT, brown, very moist.
	J-8	83/4036	15.0-22.5	0	35	65	NP	NP	NP		24.0	ML	SILT, sandy.
	J-9	83/4037	22.5-23.5	-	-	-					36.8	CL	CLAY, brown, very moist.
20A-19	J-4	83/4045	3.0- 6.0	0	4	96	26	19	7		21.7	CL-ML	CLAY
	J-8	83/4049	13.0-16.5	-	-	-					19.6	ML-CL	SILT, sandy, gray, moist.
	J-12	83/4053	25.5-28.5	0	94	6	NP	NP	NP		21.7	SP-SM	SAND
20A-20	J-3	83/4600	1.0- 2.0	-	-	-					21.3	ML	SILT, brown to dark brown, moist.
	J-6	83/4063	6.0- 9.0	0	2	98	27	21	6		28.7	CL-ML	CLAY
	J-10	83/4067	18.0-21.0	-	-	-					30.8	ML-CL	SILT, sandy, brown, wet.
	J-12	83/4069	24.5-28.0	0	9	91	32	18	14		30.4	CL	CLAY

Results of Tests of Disturbed Soil Samples

Boring No.	Field No.	SWD No.	Depth ft.	Mechanical Analysis Gr	Sa	Fi	Atterberg Limits LL	PL	PI	LS	Water Content %		Description
20A-21	J-6	83/4079	6.0- 9.5	0	4	96	22	19	3		22.8	ML	SILT, brown, moist.
	J-10	83/4083	17.5-21.0	0	25	75	28	14	14		24.9	CL	CLAY, sandy.
	J-12	83/4085	24.0-27.0	-	-	-					25.8	SM	SAND, silty, light brown, wet.
20A-22	J-5	83/4094	3.0- 6.0	0	9	91	38	18	20		27.0	CL	CLAY
	J-8	83/4097	12.0-15.0	-	-	-					30.9	ML-CL	SILT, brown, very moist.
	J-10	83/4099	18.0-21.0	0	33	67	NP	NP	NP		30.3	ML	SILT, sandy.
	J-12	83/4101	24.0-27.0	-	-	-					34.3	ML	SILT, sandy, dark brown, moist.
20A-23	J-6	83/4111	9.5-12.5	0	6	94	42	18	24		43.0	CL	CLAY
	J-8	83/4113	15.5-17.0	-	-	-					27.6	ML	SILT, dark brown, very moist.
	J-11	83/4116	23.0-26.0	0	4	96	36	17	19		38.8	CL	CLAY
	J-15	83/4120	34.0-37.0	-	-	-					36.4	ML	SILT, dark brown, wet.
20A-24	J-4	83/4125	3.0- 6.5	-	-	-					15.5	ML	SILT, sandy, brown, moist.
	J-5	83/4126	6.5- 9.5	0	7	93	50	19	31		27.9	CH	CLAY
	J-7	83/4128	12.5-15.5	0	14	86	23	20	3		29.4	ML	SILT
	J-10	83/4131	21.5-24.6	-	-	-					30.2	ML	SILT, brown, very moist.

SWD LABORATORY REPORT 13657-3

Table 1

Results of Chemical Analyses of Soils(1)

SWD Sample No.	Hole	Jar No.	Depth	Ba	Pb	Zn
83-3794	20A-25	4	6.0-6.5	108	66	4,600
83-3796		6	7.5-8.5	168	49	5,900
83-3797		7	8.5-12.5	44	378	32,000
Minimum Reported Concentration				20.0	1.0	1.0

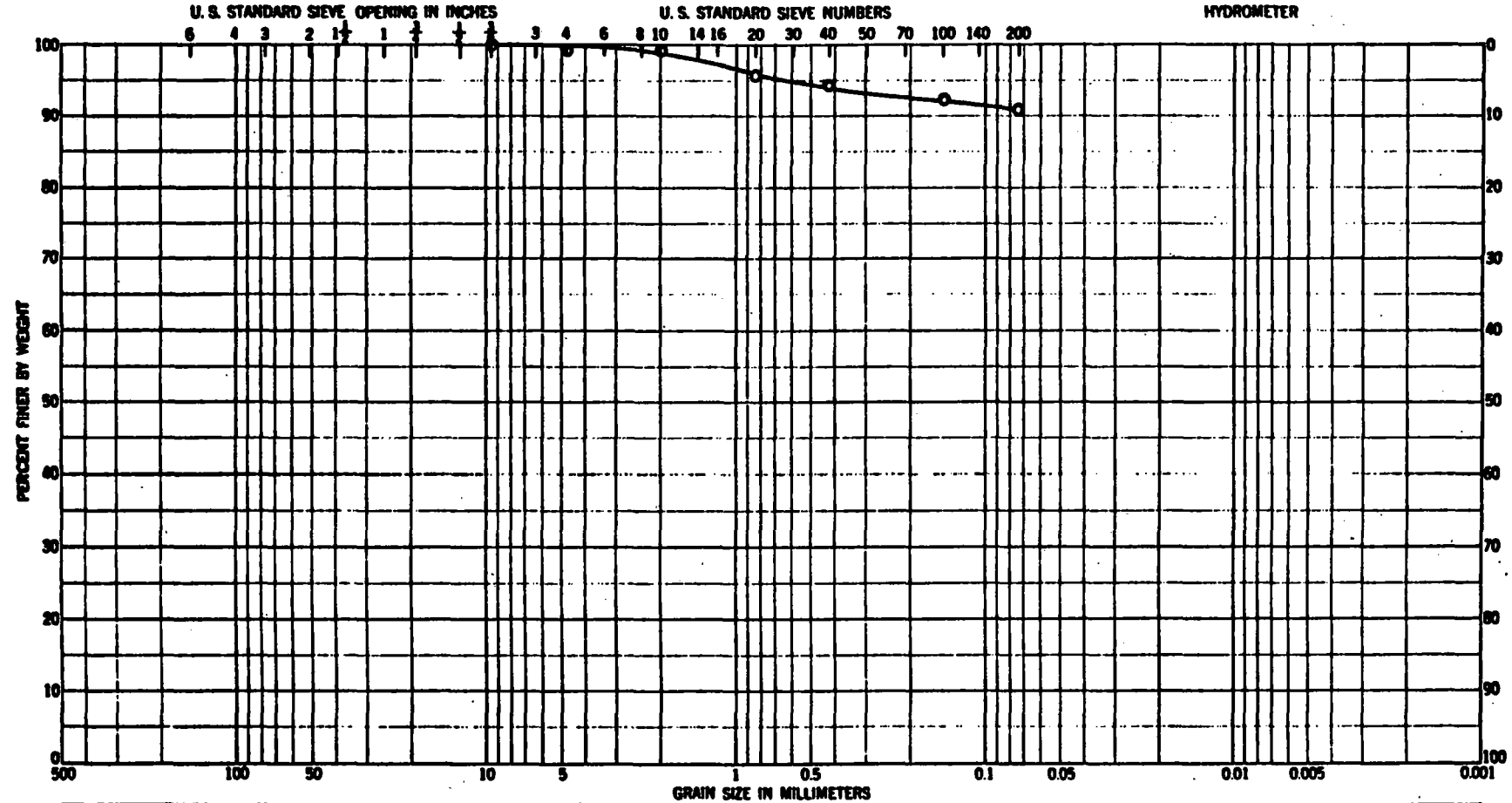
(1) All results are reported in mg/kg.

SWD LABORATORY REPORT 13657-3a

Results of Tests of Disturbed Soil Samples

Boring No.	Field No.	SWD No.	Depth Ft.	Mechanical Analysis Gr	Sa	Fi	Atterberg Limits LL	PL	PI	Water Content %	Description
20A-25	J-5	83-3795	6.5- 7.5	1	8	91	38	21	17	48.8	CL CLAY
	J-7	83-3797	8.5-12.0								CL CLAY, sandy, brown, very moist.
	J-8	83-3798	12.0-15.0	0	2	98	63	22	41	54.6	CH CLAY
	J-11	83-3801	23.5-26.5								SC SAND, clayey, brown, wet.

*Actual length of sample in feet.



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
83/3795	6.5-7.5	CLAY (CL)	48.8	38	21	17

GRADATION CURVES

Project: Pine Bluff Arsenal

Area:

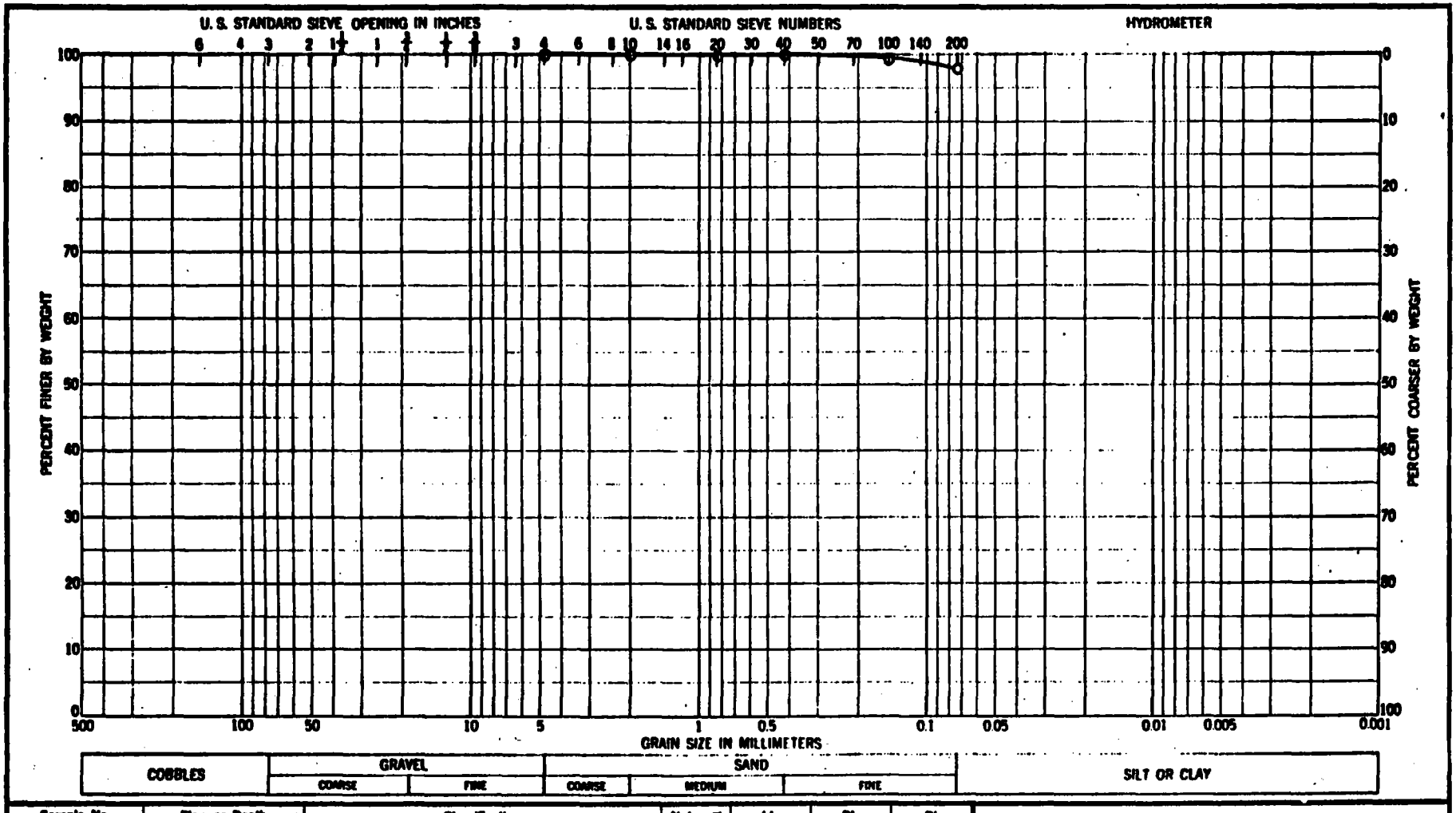
Boring No.: 20A-25

Date: December 83

SWDED-GL Report No. 13657-3a

Plate 1

ENG FORM 1 MAY 69 2087



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
83/3798	12.0-15.0	CLAY (CH)	54.6	63	22	41

GRADATION CURVES

Project: Pine Bluff Arsenal

Area:

Boring No.: 20A-25

Date: December 83

Plate 2

ENG FORM 1 MAY 69 2087

SWD LABORATORY REPORT 13657-4

Table 1

Results of Chemical Analyses of Water Samples(1)

SWD Sample No.	Field Sample No.	Ba	Pb	Zn
G-4458	20A-19	0.29	0.01	0.06
4459	20A-20	0.41	0.05	0.03
4460	20A-21	0.72	0.03	0.02
4462	20A-22	0.71	0.03	0.58
4464	20A-23	0.11	0.04	0.16
4465	20A-24	0.65	0.03	0.70
4466	20A-25	2.63	0.02	0.10

(1) All results are reported in mg/l.

Minimum Reported Concentration	0.10	0.01	0.01

APPENDIX II
BORING - CONTAMINANT PLOTS

APPENDIX II
BORING CONTAMINANT PLOTS

LEGEND

Burned Fill Material

CL

CH

ML — Unified soil classification system

SP

SM

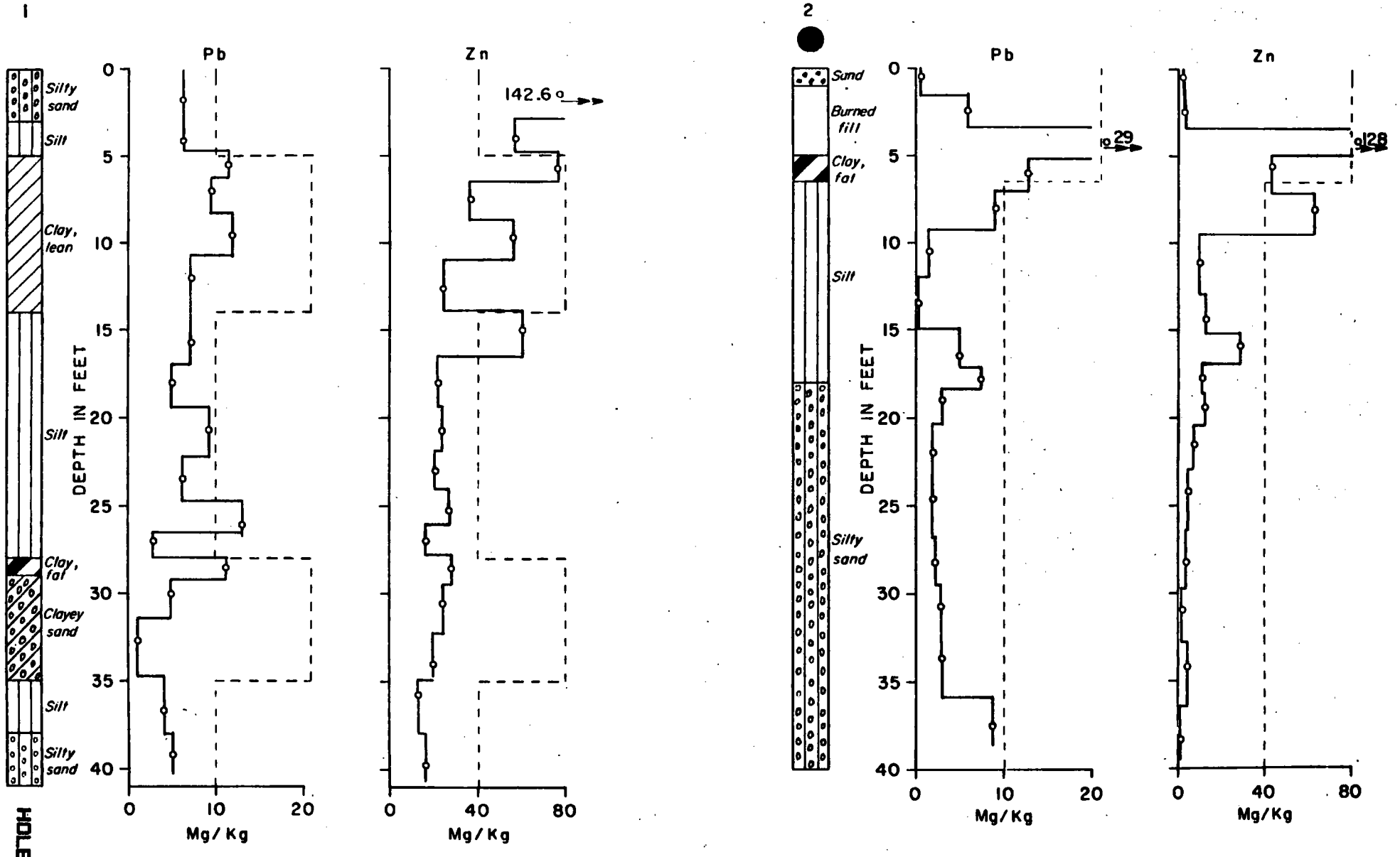
SC

Middepth of soil sample tested for ion concentration.

Middepth of soil sample tested for both total ion concentration and EP toxicity. Values for EP toxicity are shown in table 3.2.

Upper limit of 95% confidence interval determined from background concentration levels.

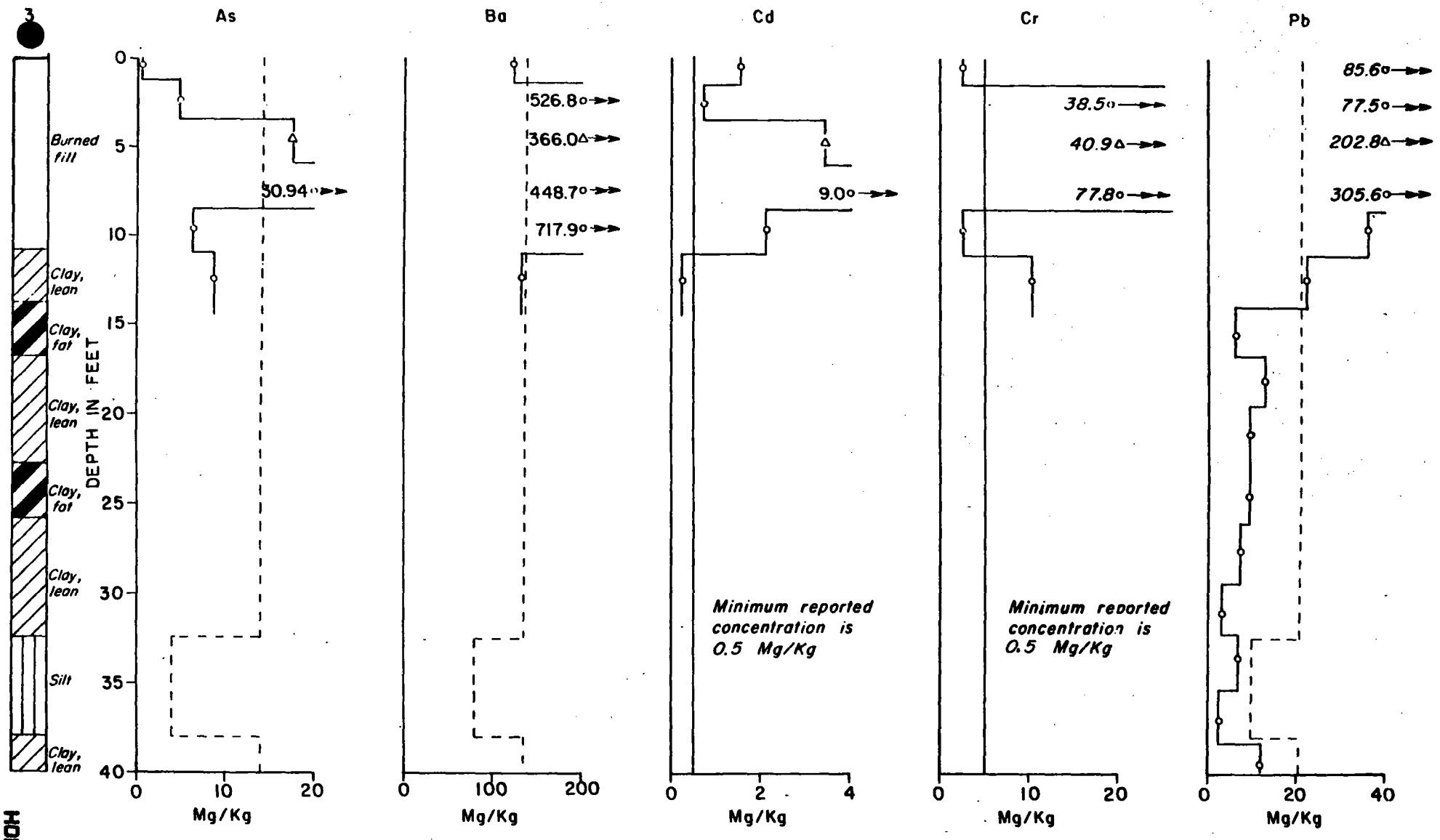
Minimum reported value (Concentrations less than minimum reported values are shown as ½ minimum reported values).



HOLE NO. 1

HOLE NO. 2

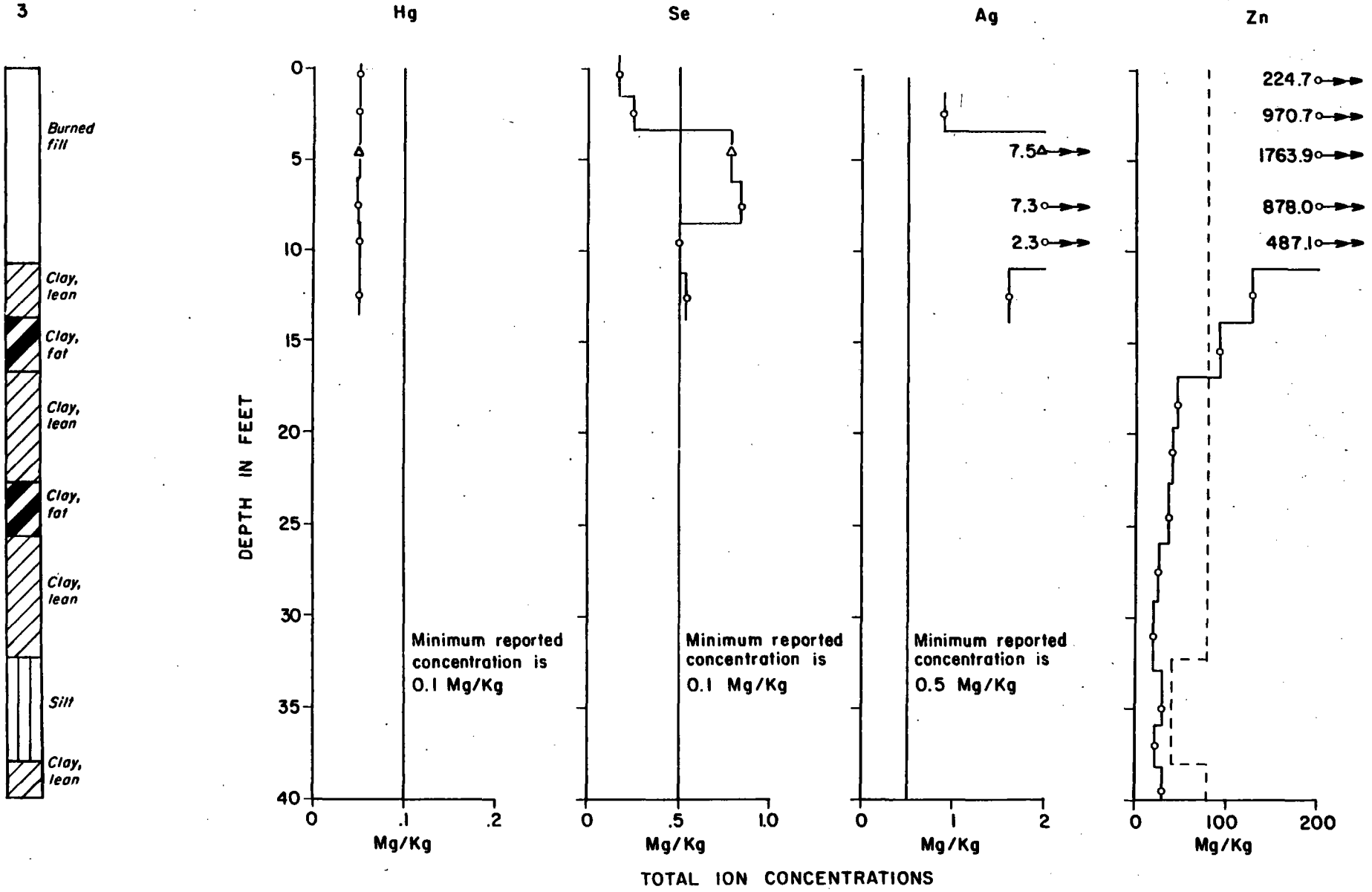
BORING CONTAMINANT PLOT



TOTAL ION CONCENTRATIONS

BORING CONTAMINANT PLOT

HOLE NO. 3



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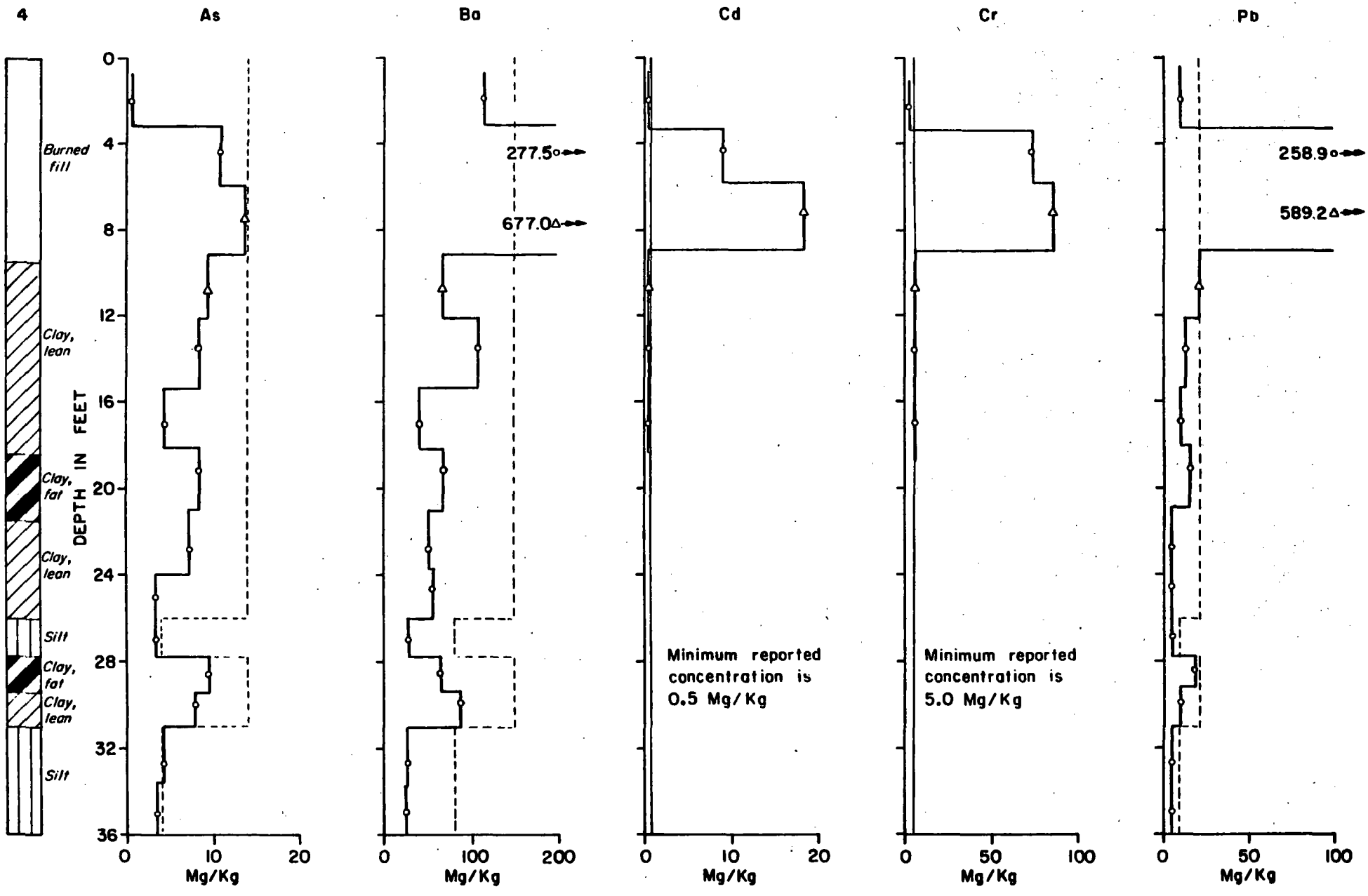
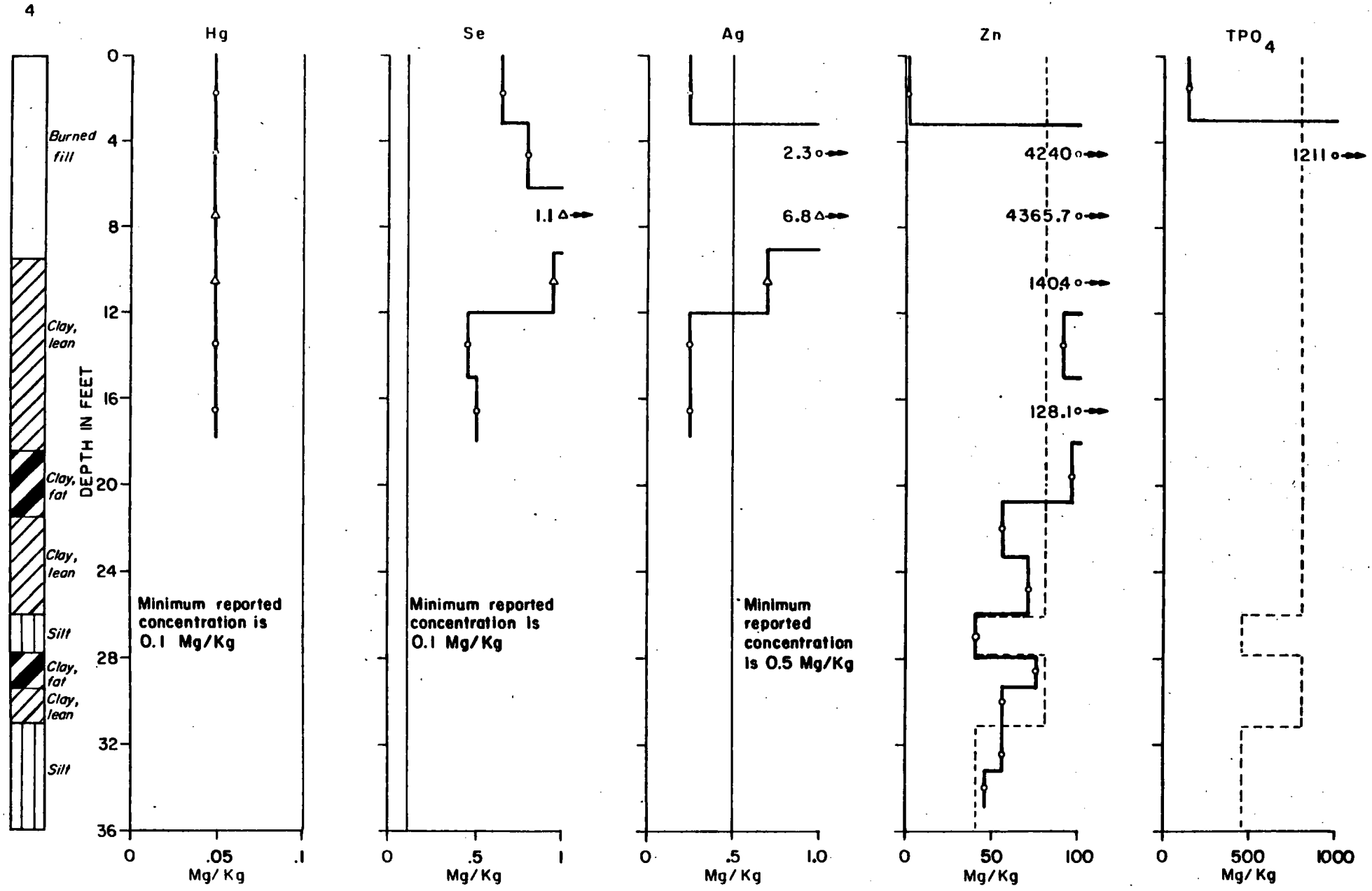
HOLE NO. 3



TOTAL ION CONCENTRATIONS

BORING CONTAMINANT PLOT

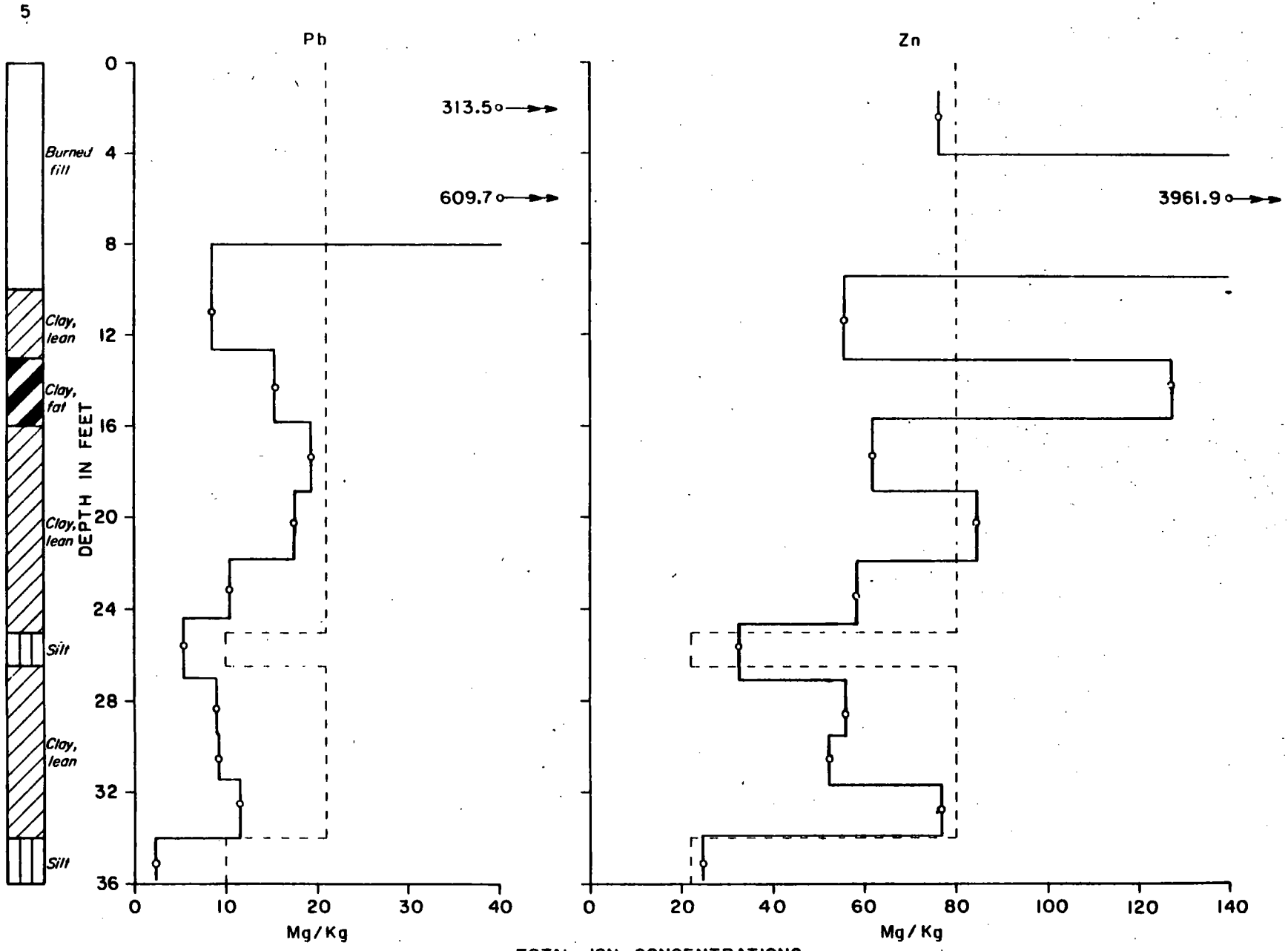
HOLE NO. 4



TOTAL ION CONCENTRATIONS

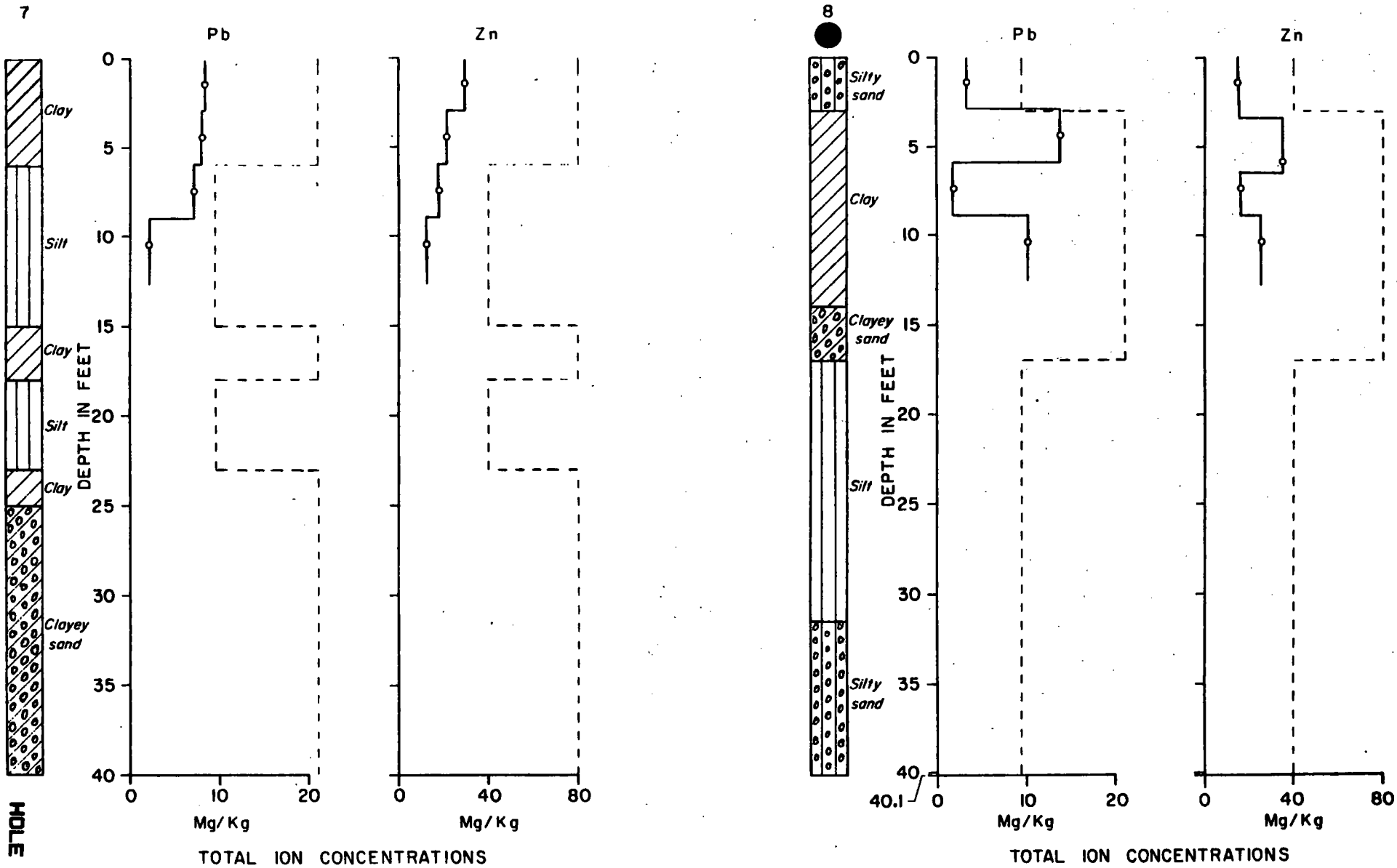
BORING CONTAMINANT PLOT

HOLE NO. 4



HOLE NO. 5

BORING CONTAMINANT PLOT



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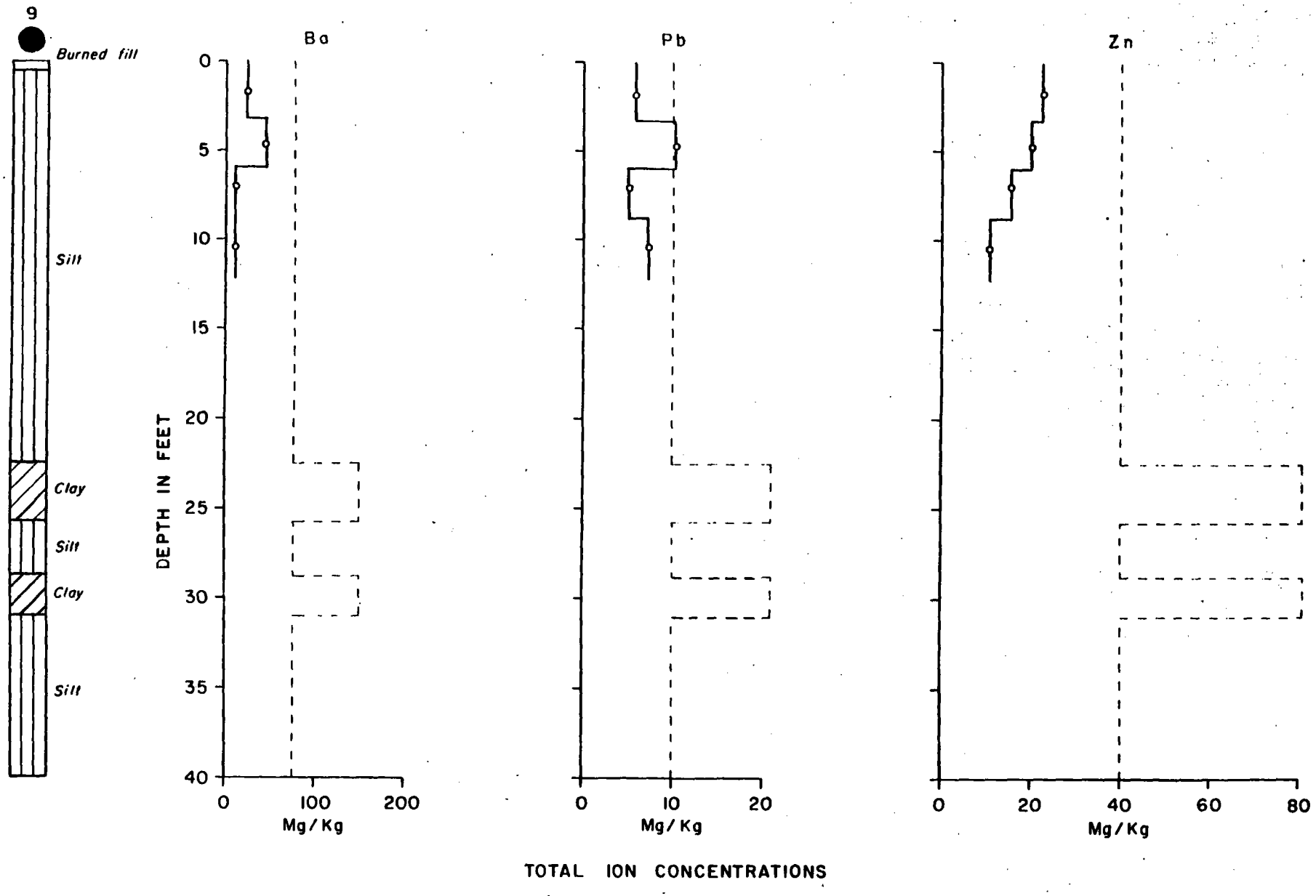
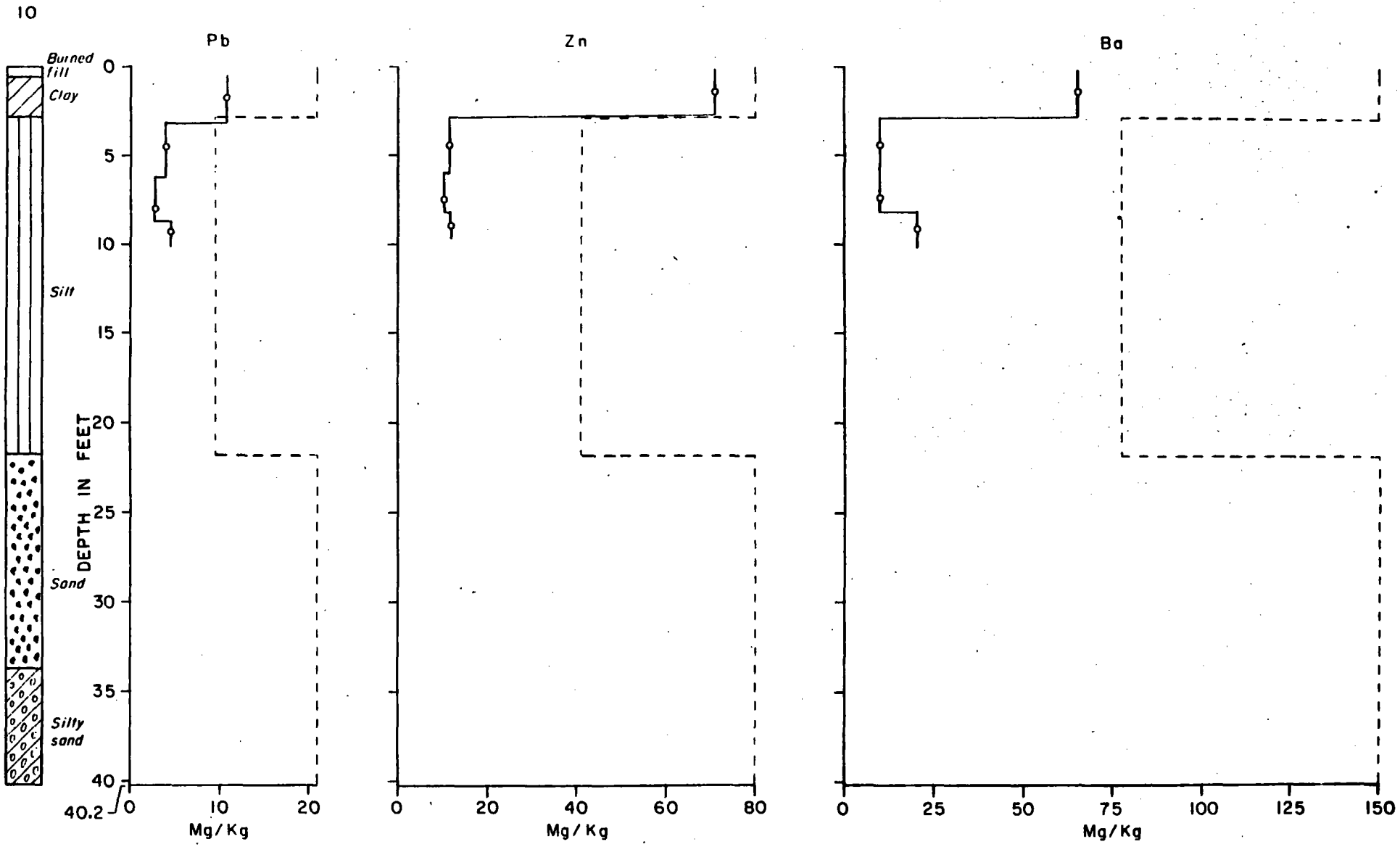


TOTAL ION CONCENTRATIONS

BORING CONTAMINANT PLOT

HOLE NO. 9

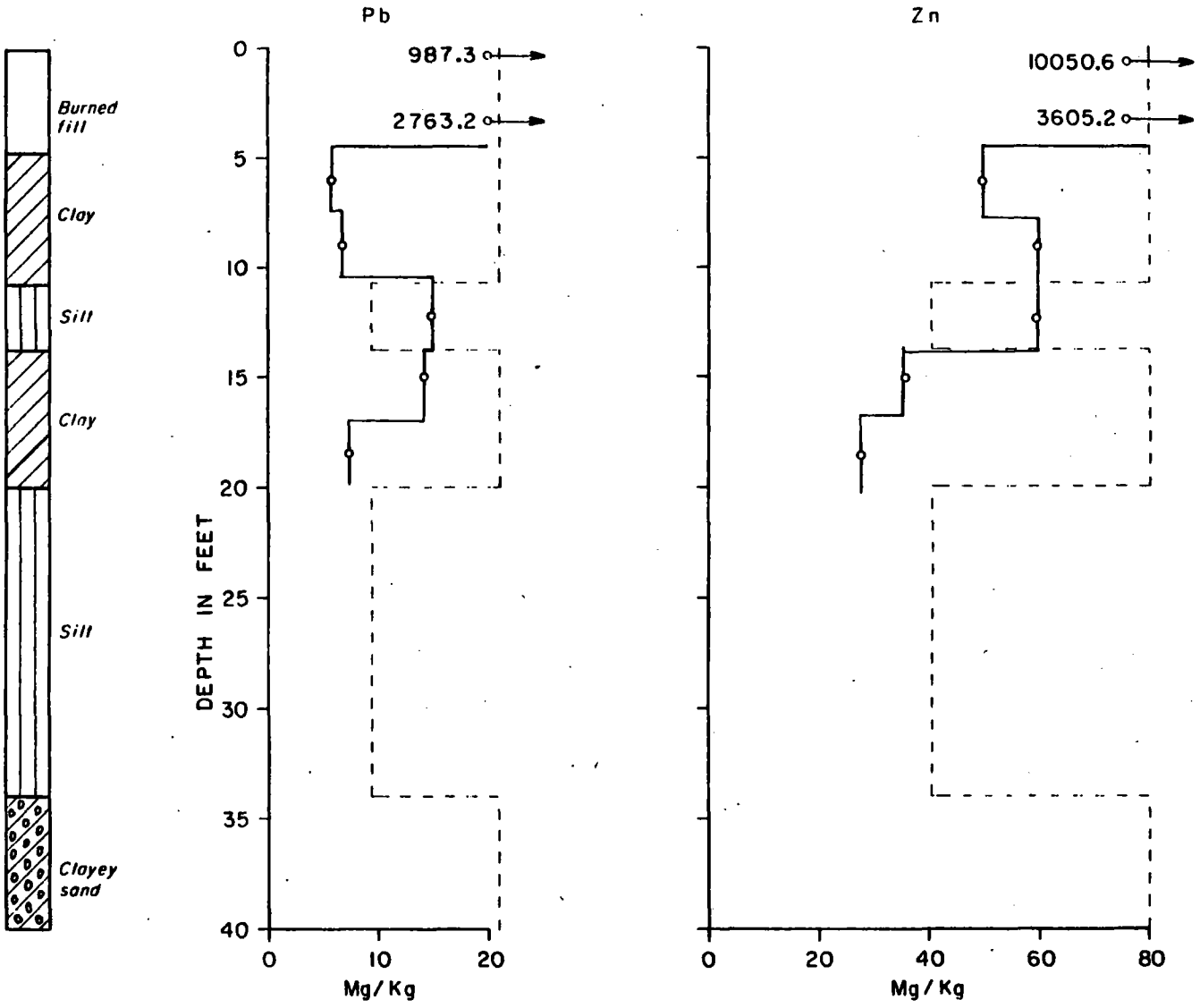


TOTAL ION CONCENTRATIONS

BORING CONTAMINANT PLOT

HOLE NO. 10

11

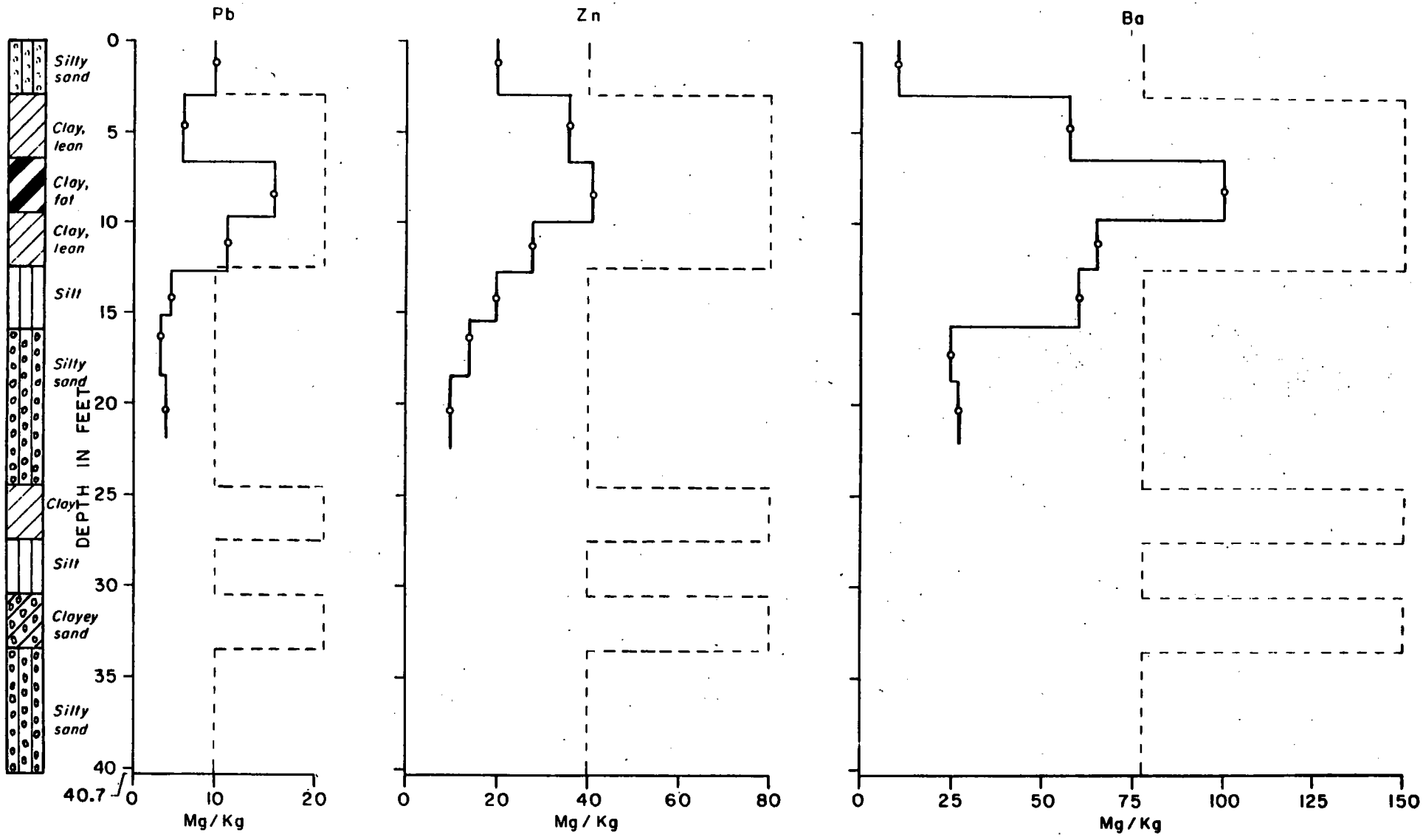


TOTAL ION CONCENTRATIONS

BORING CONTAMINANT PLOT

HOLE NO. 11

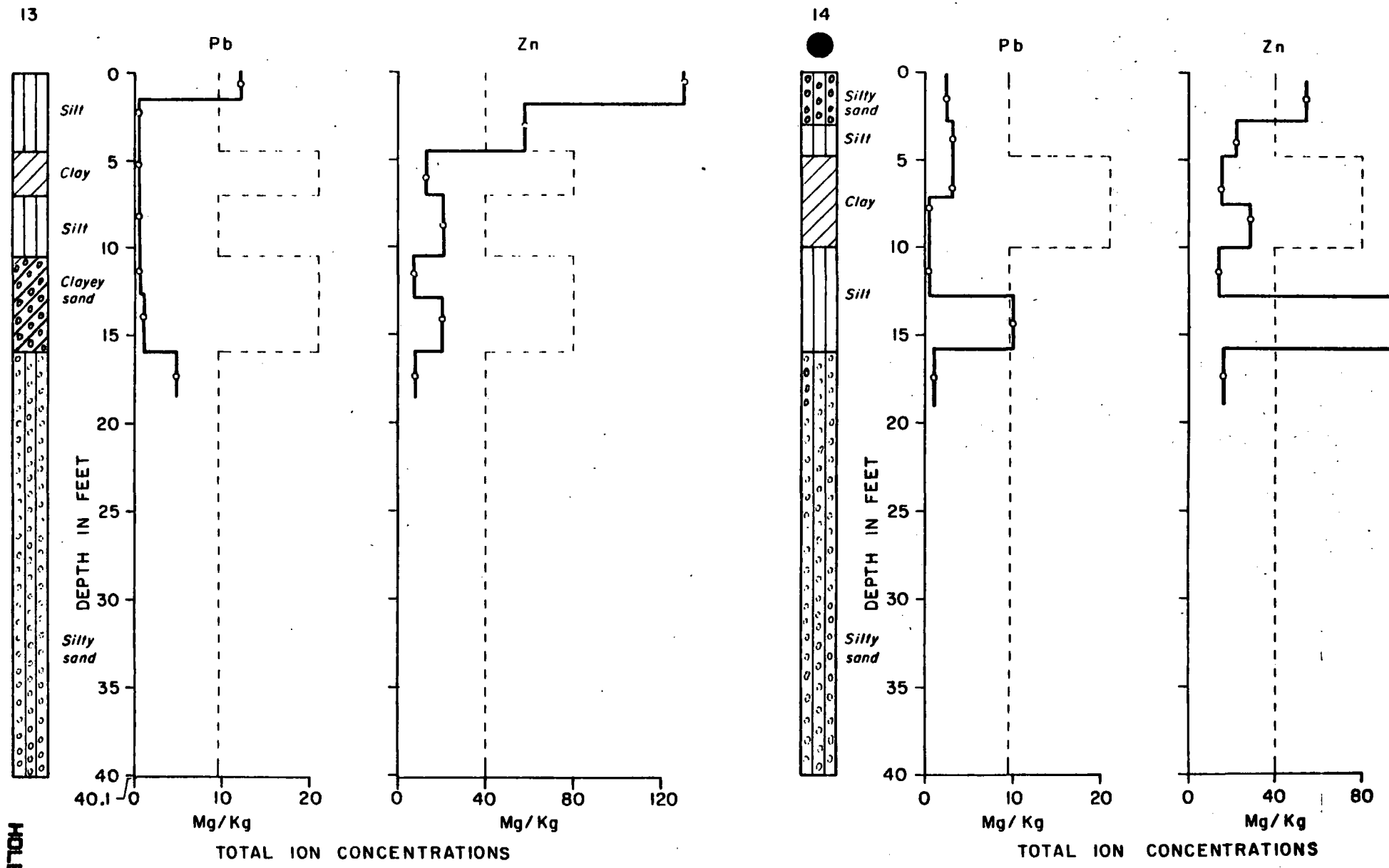
12



TOTAL ION CONCENTRATIONS

BORING CONTAMINANT PLOT

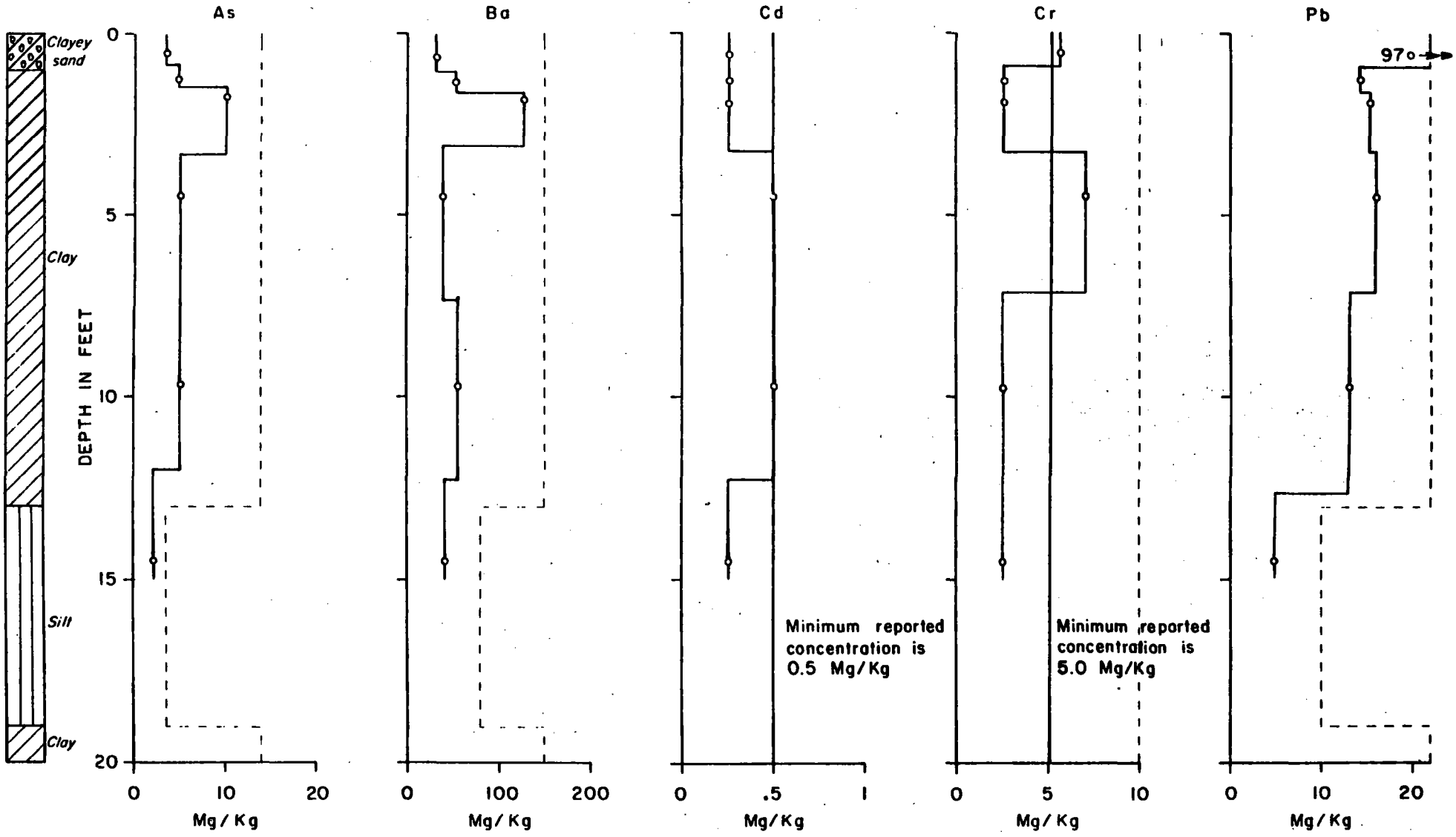
HOLE NO. 12



BORING CONTAMINANT PLOT

HOLE NO. 13

HOLE NO. 14

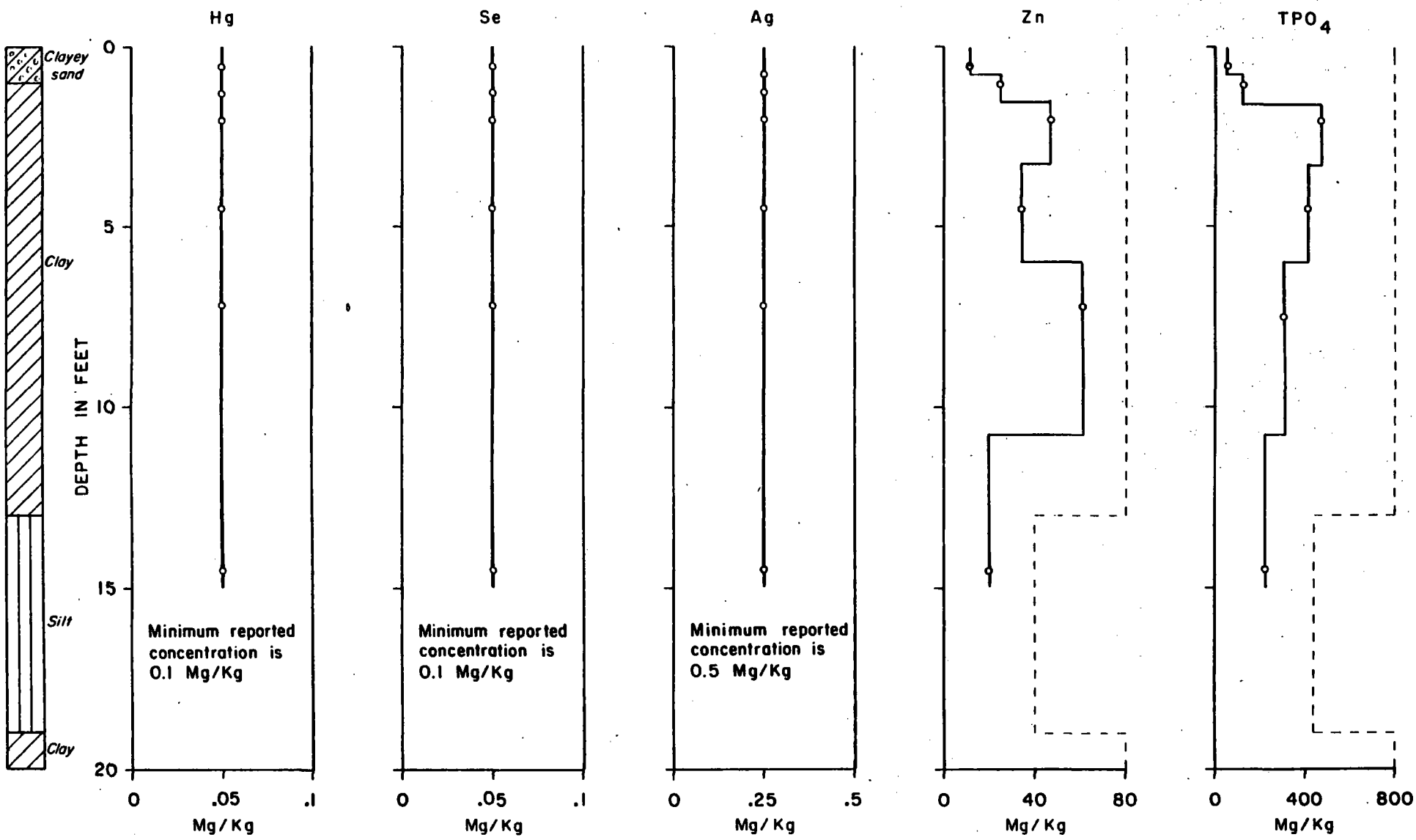


TOTAL ION CONCENTRATIONS

BORING CONTAMINANT PLOT

HOLE NO. 15

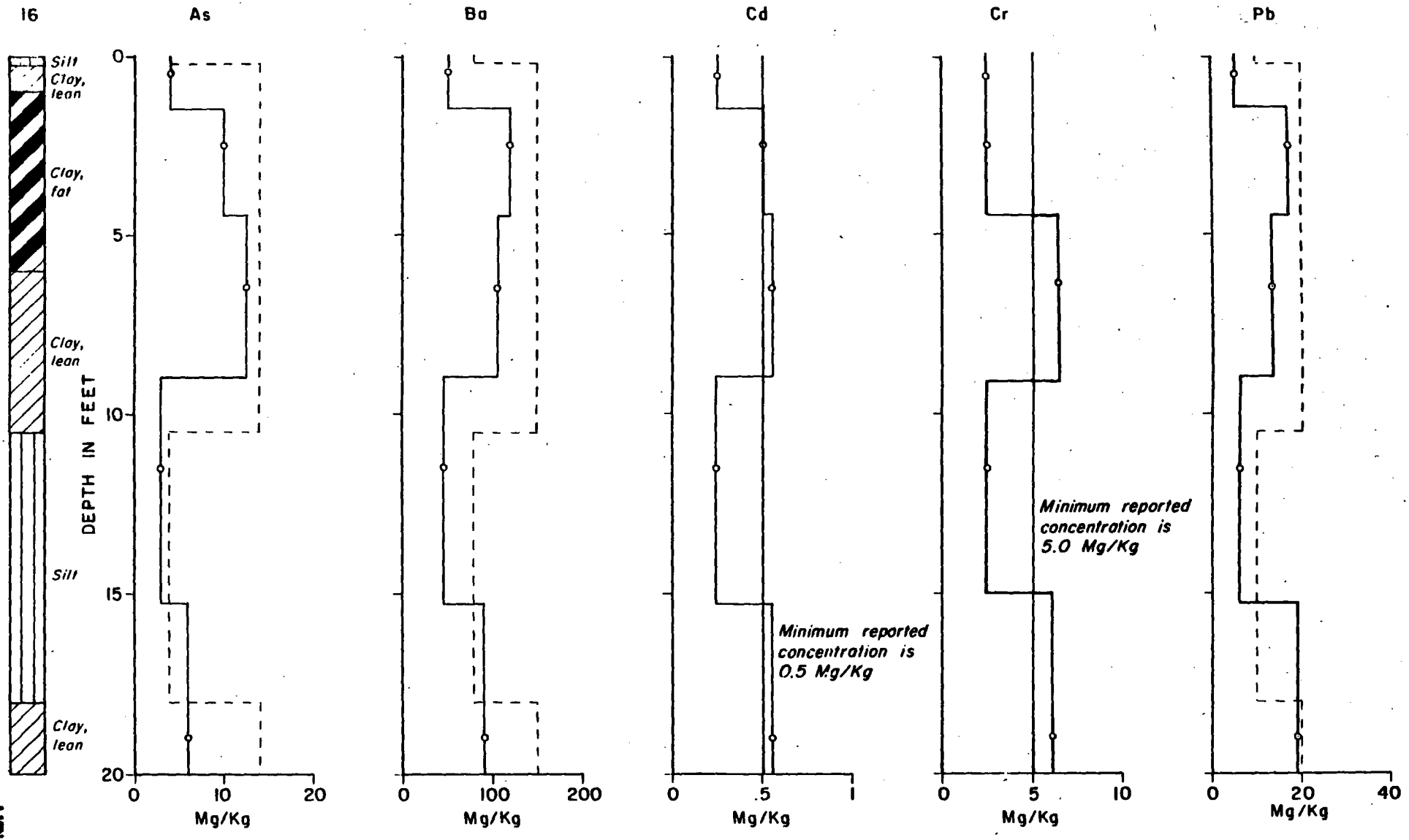
15



TOTAL ION CONCENTRATIONS

BORING CONTAMINANT PLOT

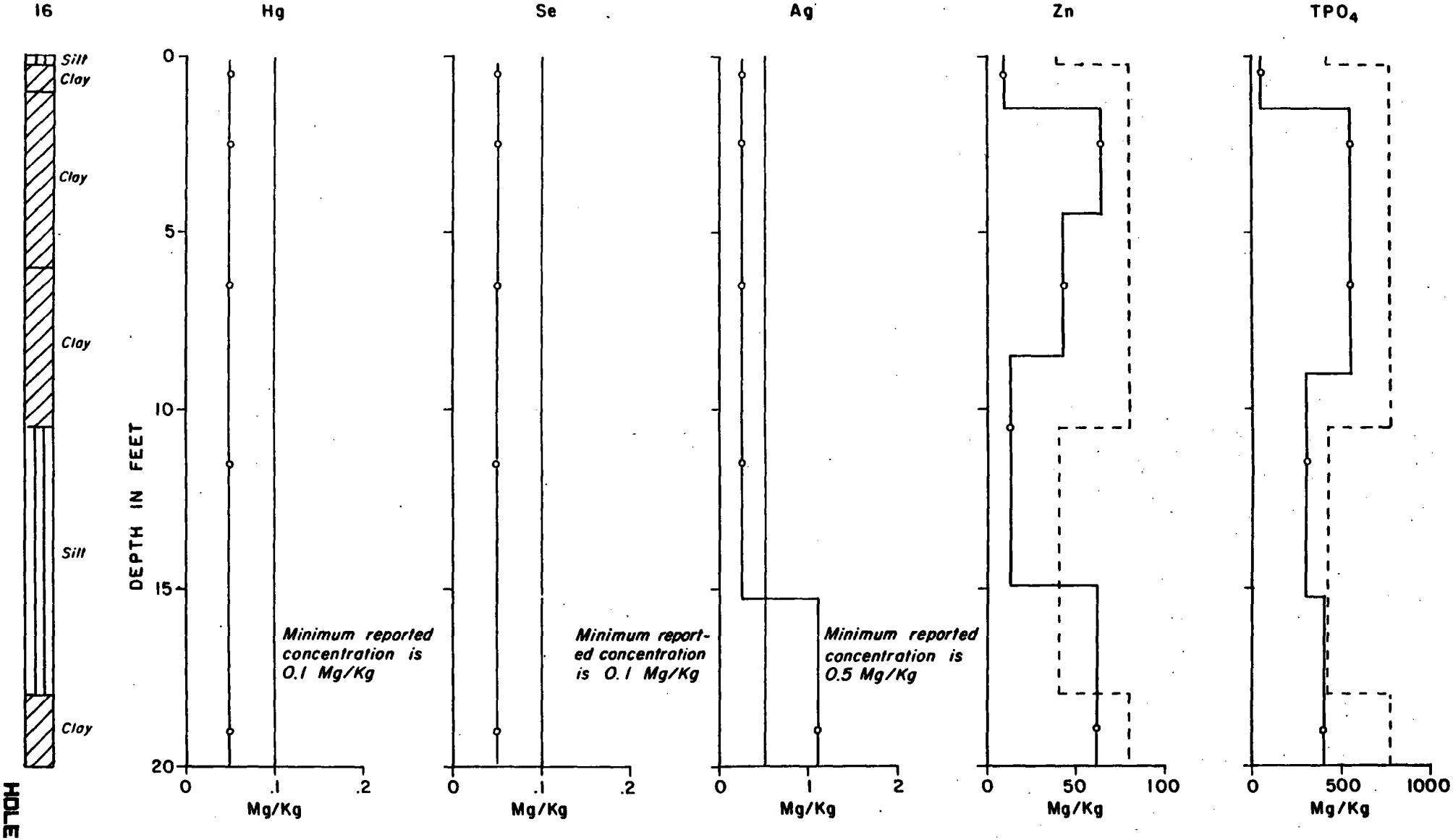
HOLE NO. 15



TOTAL ION CONCENTRATIONS

BORING CONTAMINANT PLOT

HOLE NO. 16



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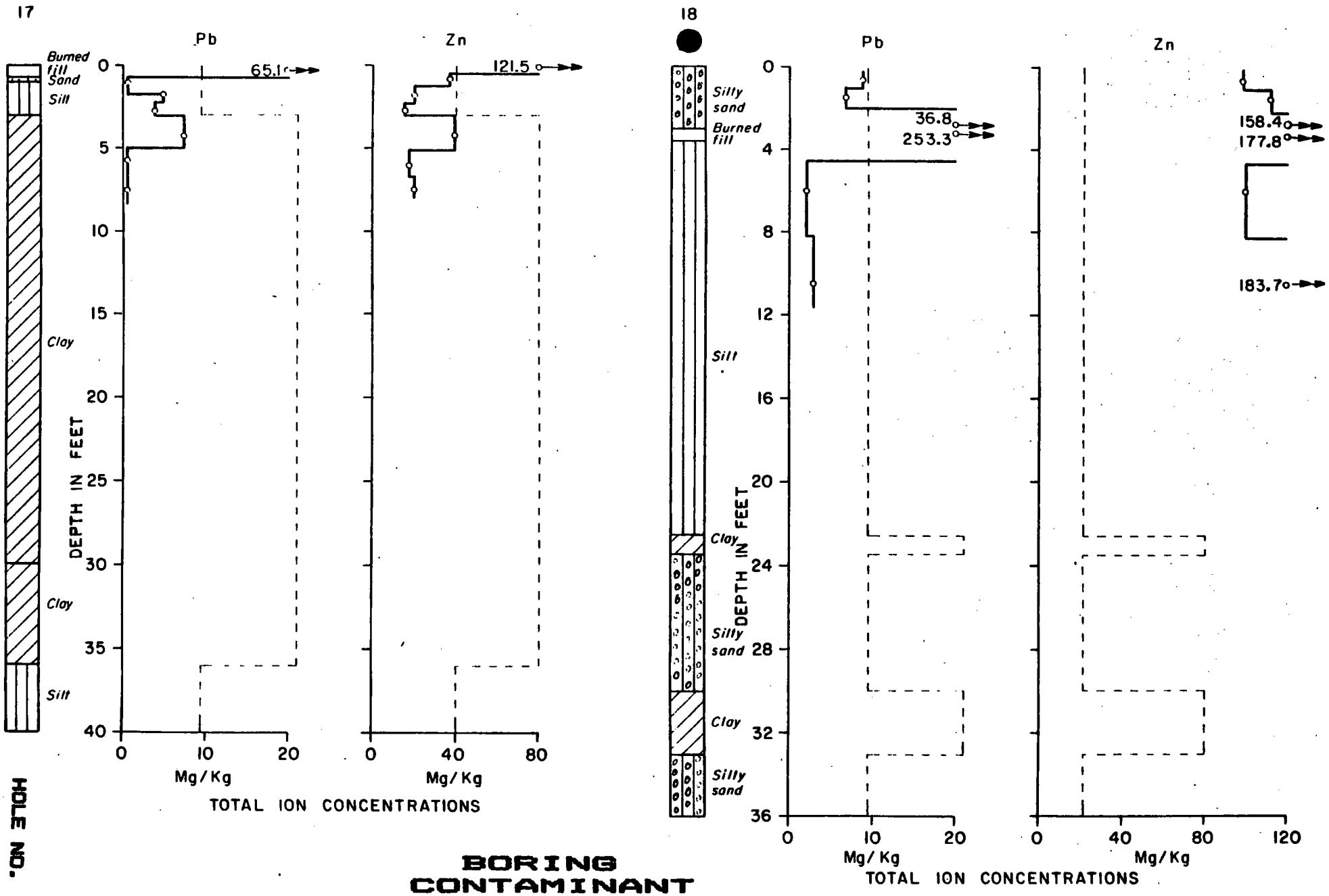
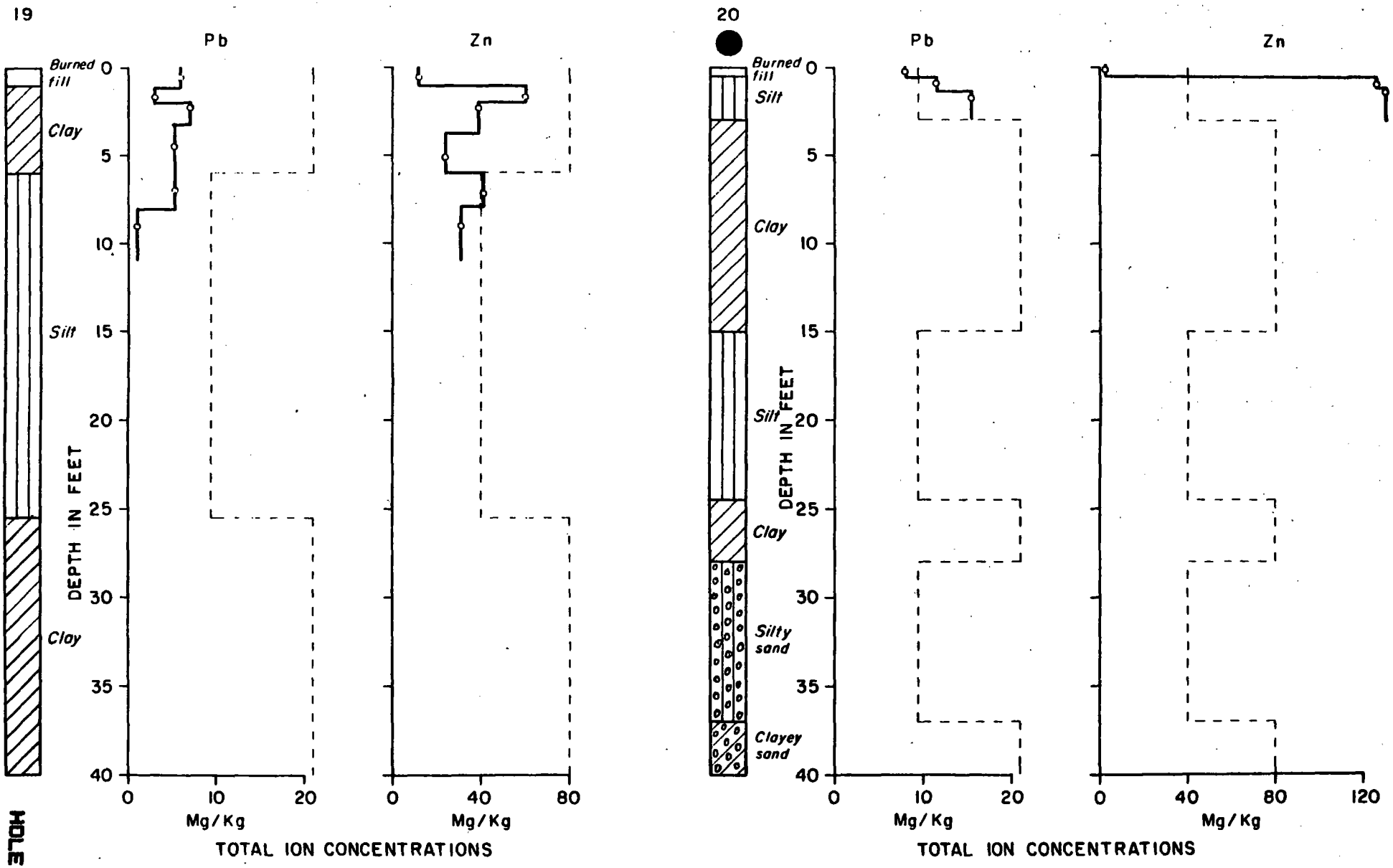


HOLE NO. 17

HOLE NO. 18

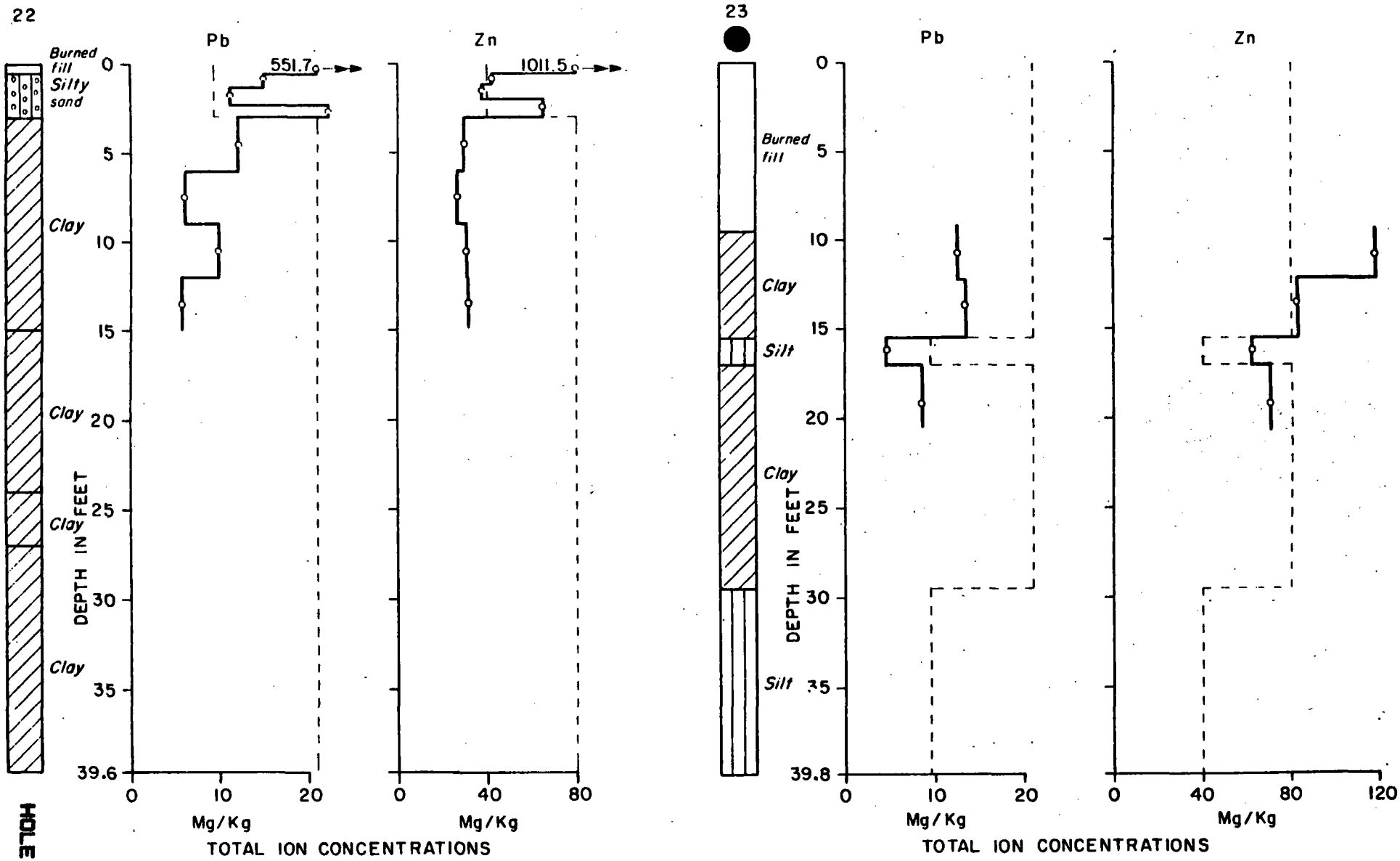
BORING CONTAMINANT PLOT



HOLE NO. 19

HOLE NO. 20

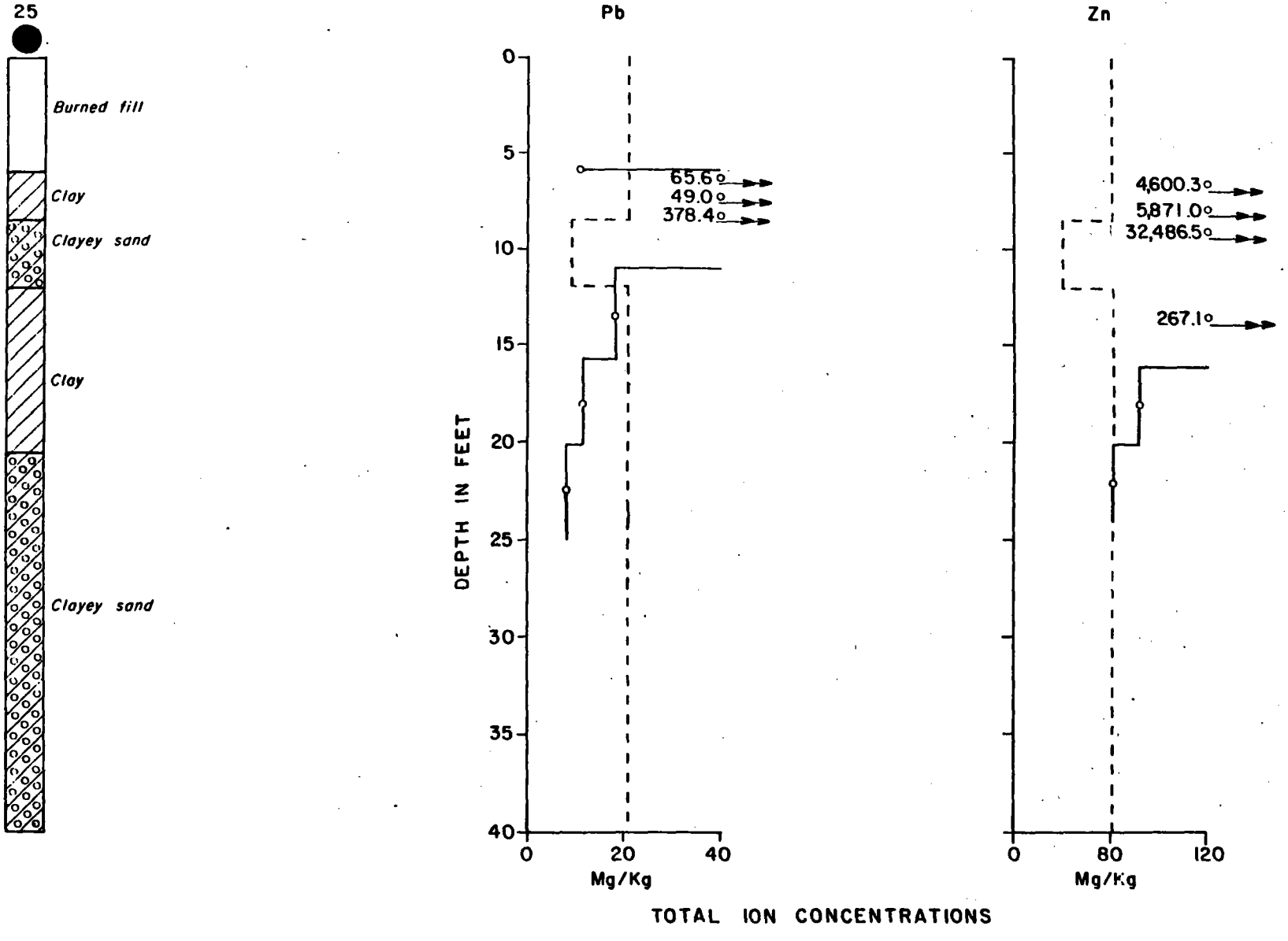
BORING CONTAMINANT PLOT



HOLE NO. 22

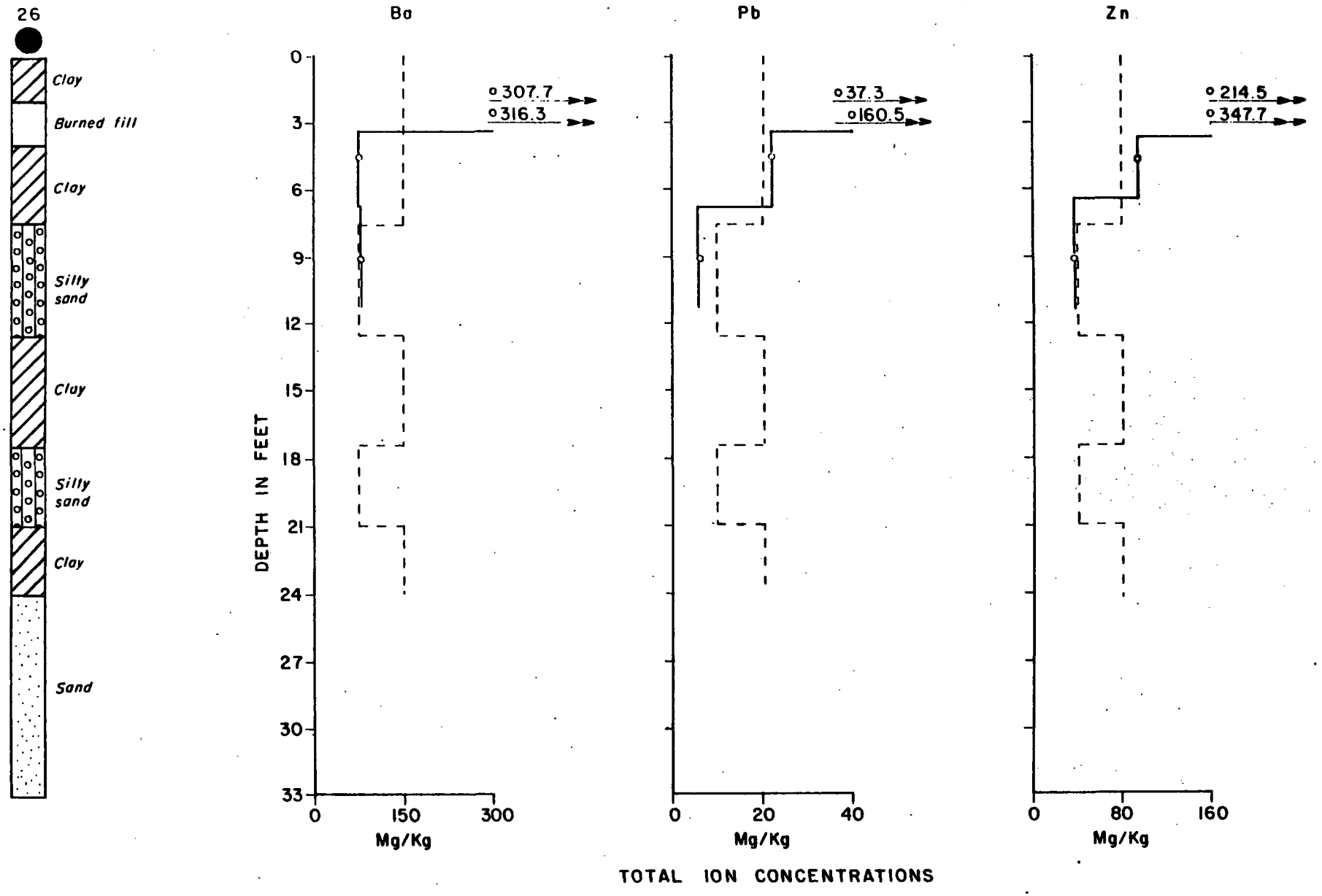
HOLE NO. 23

BORING CONTAMINANT PLOT



BORING CONTAMINANT PLOT

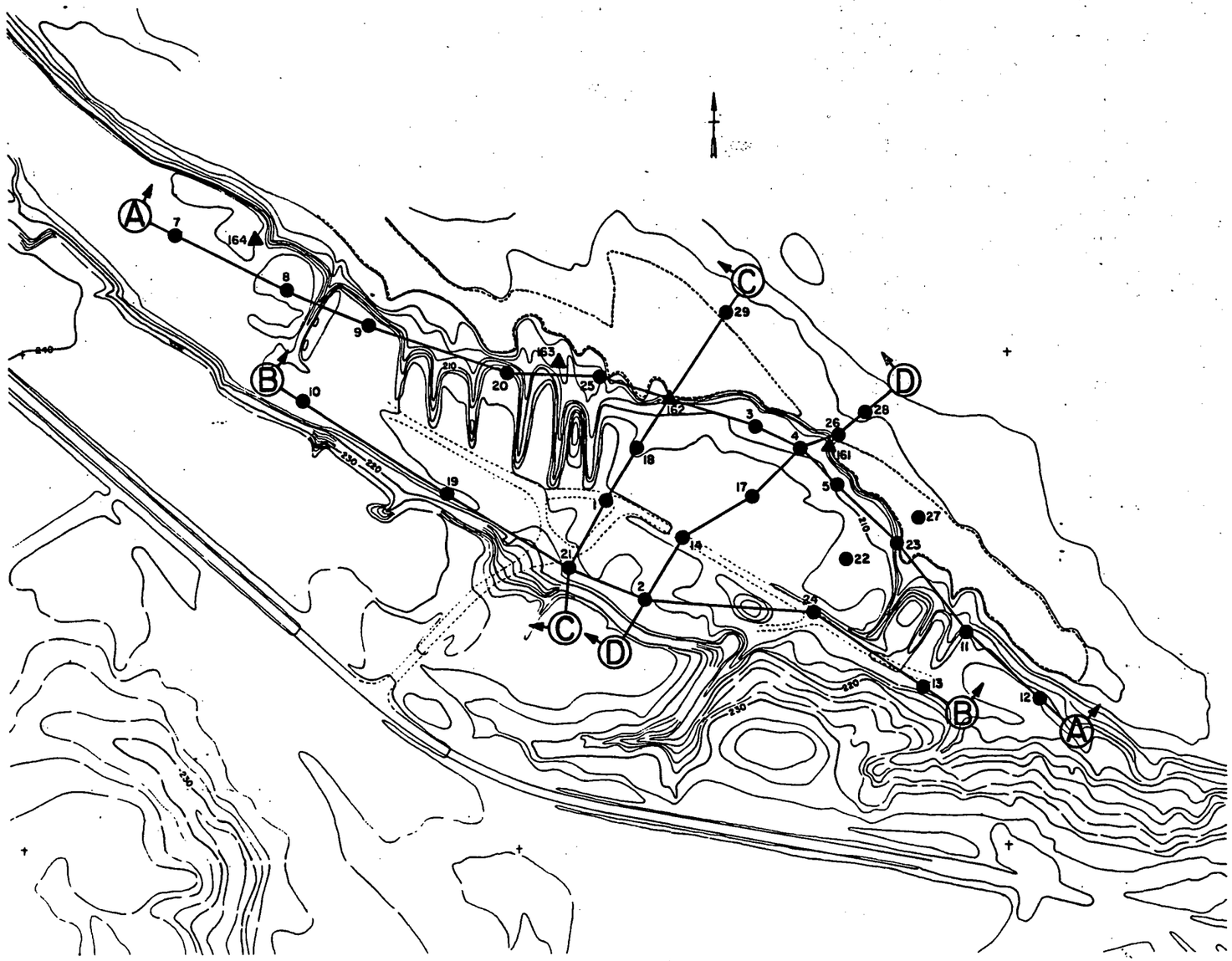
HOLE NO. 25



BORING CONTAMINANT PLOT

HOLE NO. 26

DRAWINGS



LEGEND

- ● AUGER HOLE
- ▲ MONITORING WELL

SCALE OF FEET
100 0 100 200

Revisions			
Symbol	Descriptions	Date	Approved

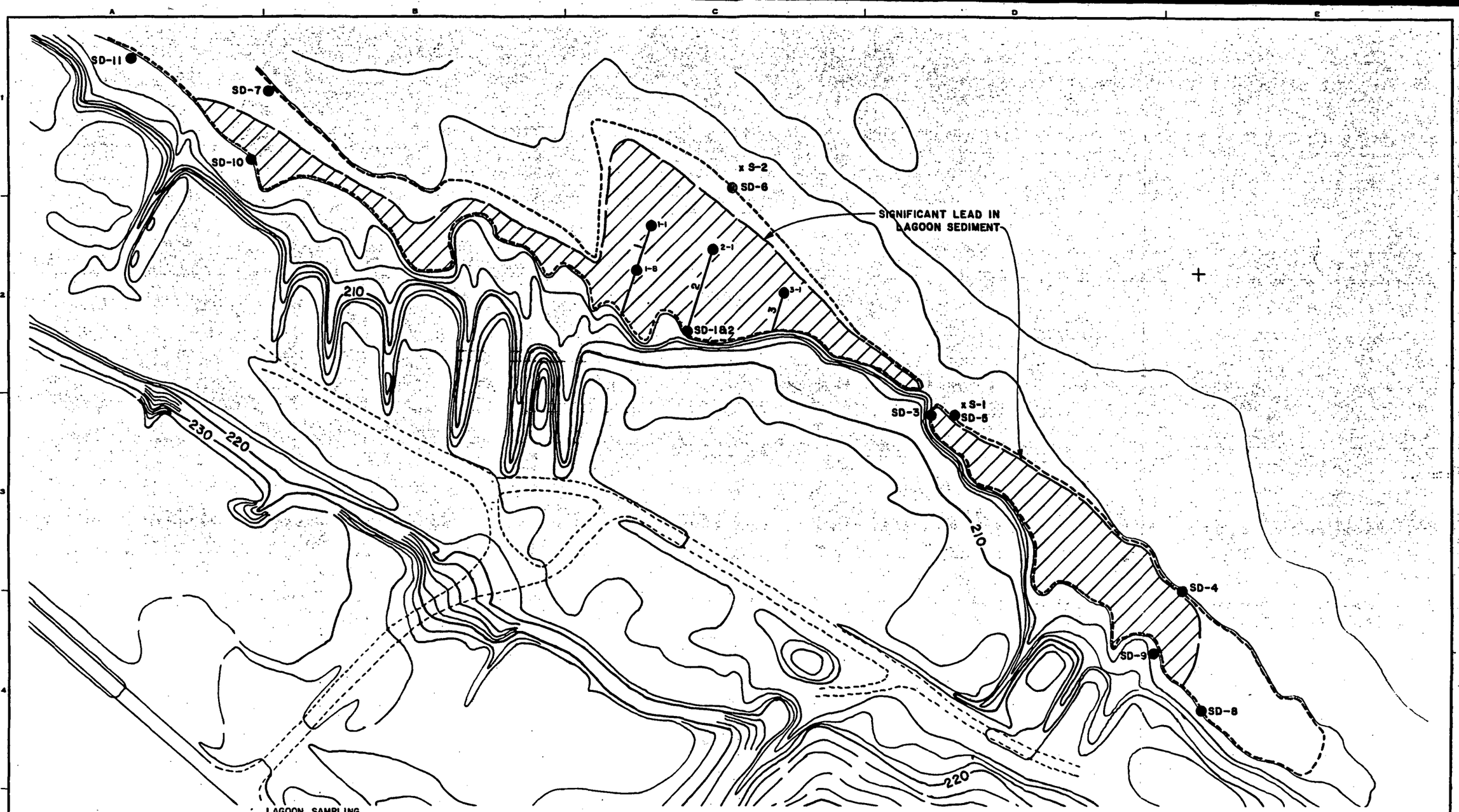
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
TULSA, OKLAHOMA

Designed by Joseph A. Hamblett
Drawn by Steven M. McCann
Checked by E.M. Gilbert
Submitted by
Chief

PINE BLUFF ARSENAL
PINE BLUFF, ARKANSAS
PW-008300 FY-86
HAZARDOUS LANDFILL/CLOSURE SITES

SITE 20A
PLAN OF EXPLORATIONS

Scale
Date
Dwng Copy
Sheet reference number
Sheet 1 of 8



LAGOON SAMPLING

	Sample #	Depth	Distance from SW Shore	Lead	Zinc	Barium	Silver	Arsenic	Chromium	Cadmium	Selenium	Mercury	Total Phosphate
Transect 1	1-1	0	123'	40.0	507.5	20	.5	11.5	10.0	2.5	0.6	.1	927
Transect 2	1-8	0	53'	194.3	4,571.6								
	2-1	0	135'	107.1	364.1	167.1	.5	14.1	10.6	11.8	0.9	.1	1232
	2-1	1.0'	115'	4.5	91.3	132.7	.5	8.5	5.0	.5		.1	601
	2-3	1.3'	105'	12.3	66.6	111.9							
	2-5	1.3'	95'	14.8	523.1	148.9							
	2-6	1.0'	90'	18.1	8.6	91.1							
	2-9	1.5'	75'	7.5	4.1	85.1							
	2-12	1.5'	60'	3.2	219.6	96.0							
	2-15	1.5'	45'	10.0	1,966.7	97.2							
	2-18	1.5'	30'	12.5	1,278.0	109.3							
	2-20	1.5'	20'	256.5	10,836.4	119.1							
	2-23	0	15'	434.2	846.9	20							
	2-23	1.5'	15'	9.8	2,356.8	219.2			12.7	18.0			
Transect 3	3-1	0	57'	40.0	616.7	93.9							
Grab samples*	SD-1	0		491.7	1,970.9		.5	12.4	5.0	2.7		.1	1504
	SD-2	0		1078.2	7,709.1								
	SD-3	0		234.3	1,524.3	133.4							
	SD-4	0		38.3	1,325.0	217.4							
	SD-5	0		4.3	1,665.2	67.8							
	SD-6	0		3.7	261.5	135.4							
	SD-7	0		5.6	191.5	115.8							
	SD-8	0		9.8	562.3	94.4							
	SD-9	0		35.4	504.5	113.2							
	SD-10	0		11.2	661.8	38.2							
	SD-11	0		3.6	171.4	71.4							
Soil Samples *	S1	0		8.9	100.1	142.4							
	S2	0		12.6	228.6	158.7							

*Samples taken 5' from nearest shore.

SCALE OF FEET
50 0 50 100

LEGEND

- X SOIL SAMPLES
- ● LAGOON SEDIMENT SAMPLES
- 2 TRANSECT LINE

Symbol	Revisions: Description	Date	Approved

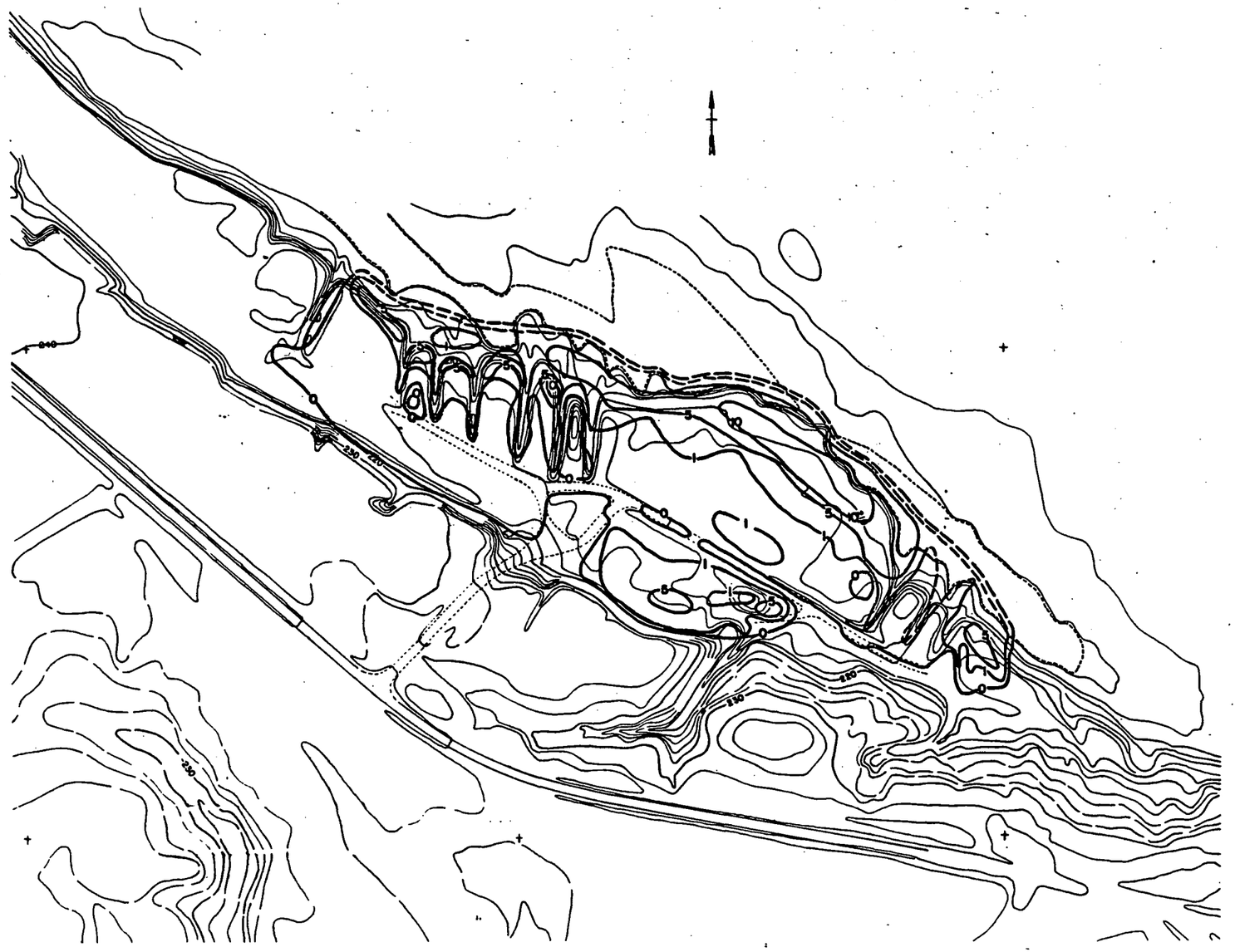
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
TULSA, OKLAHOMA

Designed by: Joseph P. Oberth
Drawn by: Steven McCann
Checked by: E.N. Gilbert
Submitted by:
Chief:

PINE BLUFF ARSENAL
PINE BLUFF, ARKANSAS
PN-003300 FY-86
HAZARDOUS LANDFILL/CLOSURE SITES

SITE 20A
LAGOON SAMPLING AND RESULTS

Scale
Date
Dwg Code
Sheet reference number
Sheet 2 of 8



ISOPACH OF THE BURNED FILL
(IN FEET)

SCALE OF FEET
100 0 100 200

Symbol	Revisions: Descriptions	Date	Approved

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
TULSA, OKLAHOMA

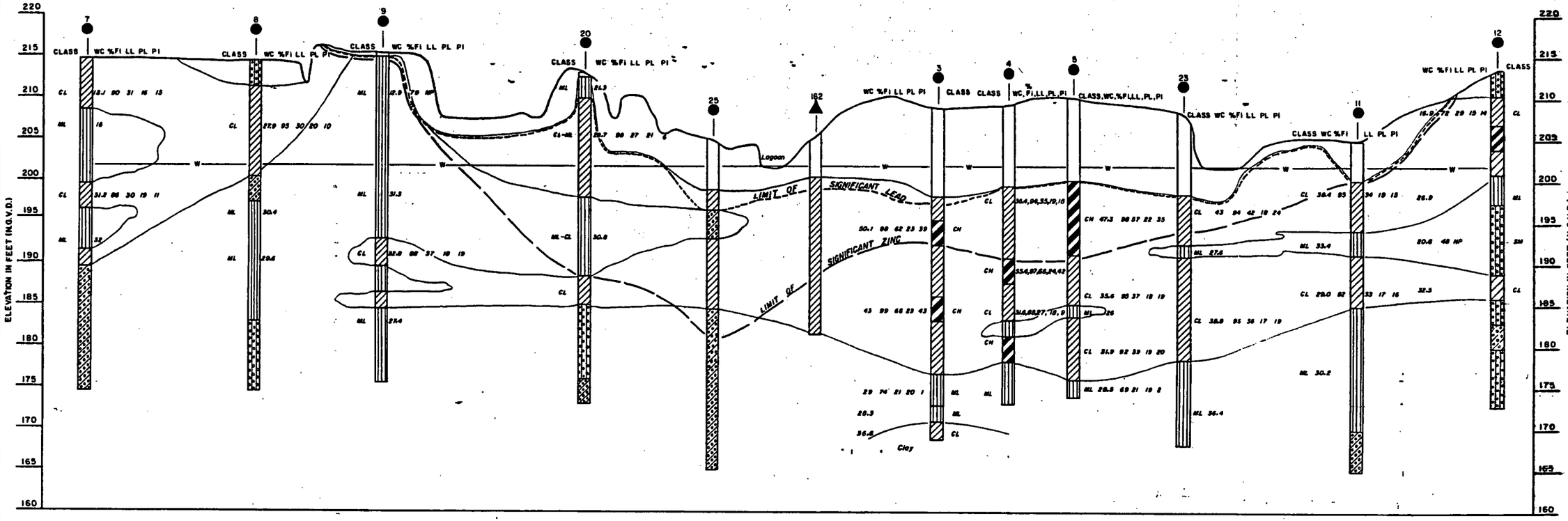
Designed by: Joseph J. Booth
Drawn by: Steven McCann
Checked by: Ed Gilbert

PINE BLUFF ARSENAL
PINE BLUFF, ARKANSAS
PN 008300 FY-88
HAZARDOUS LANDFILL / CLOSURE SITES
SITE 20A
ISOPACH OF THE BURNED FILL

Submitted by:
Chief,

Scale:
Date:
Dwg Code:
Sheet reference number:

Sheet 3 of 8



GEOLOGIC SECTION A-A

SCALE IN FEET

60 0 60 120

LEGEND

- CORE HOLE
- MONITORING WELL
- W — WATER TABLE
- —— LOWER LIMIT OF SIGNIFICANT LEAD
- – – – LOWER LIMIT OF SIGNIFICANT ZINC
- FILL MATERIAL
- CL
- CH
- SC
- SP
- SM
- ML
- WC — WATER CONTENT
- %FI - PERCENT FINES
- LL — LIQUID LIMIT
- PL — PLASTIC LIMIT
- PI — PLASTICITY INDEX

Revisions			
Symbol	Descripcions	Date	Approved

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
TULSA, OKLAHOMA

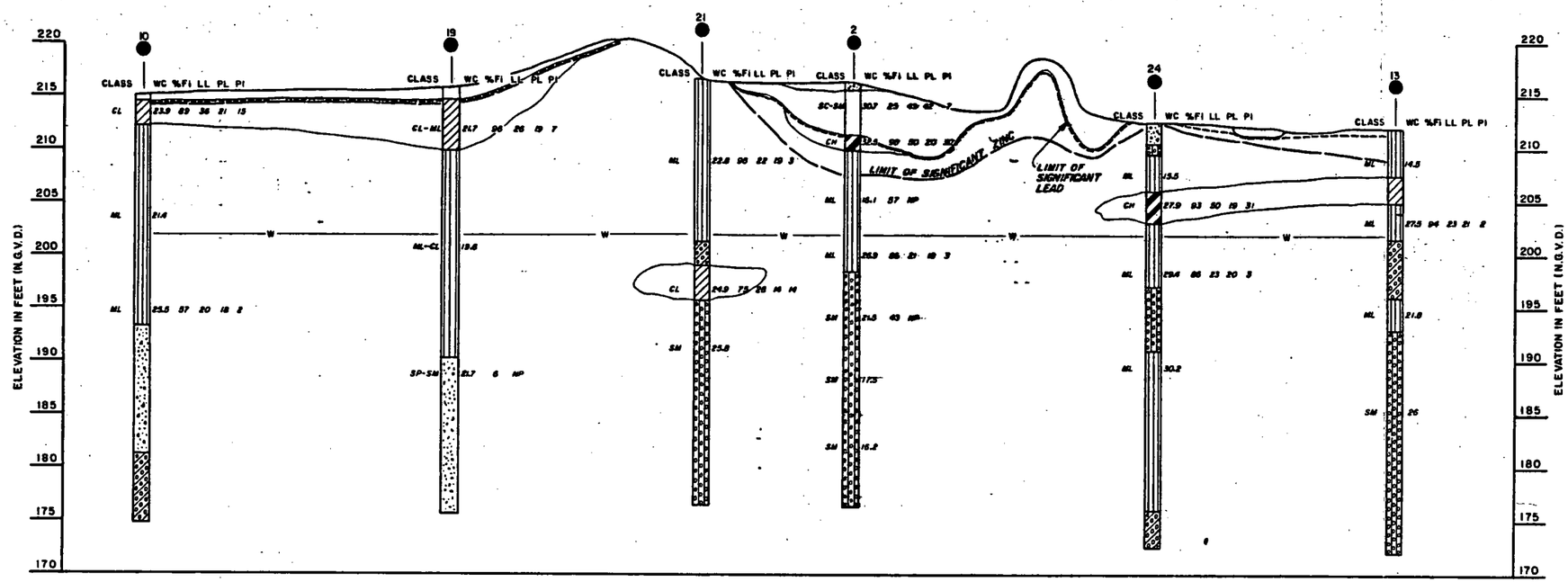
Designed by: Joseph A. Olmstead
Drawn by: Steven McCann
Checked by: E.N. Hilliard
Submitted by:
Chief:

PINE BLUFF ARSENAL
PINE BLUFF, ARKANSAS
PN: 008300 FY-86
HAZARDOUS LANDFILL/CLOSURE SITES

SITE 20A
GEOLOGIC SECTION A-A

Scale:
Date:
Dwg Code:
Sheet reference number:

Sheet 4 of 8



GEOLOGIC SECTION B-B

SCALE IN FEET

60 0 60 120

NOTE: FOR LEGEND SEE DRAWING NUMBER 4.

Revisions			
Symbol	Descriptions	Date	Approved

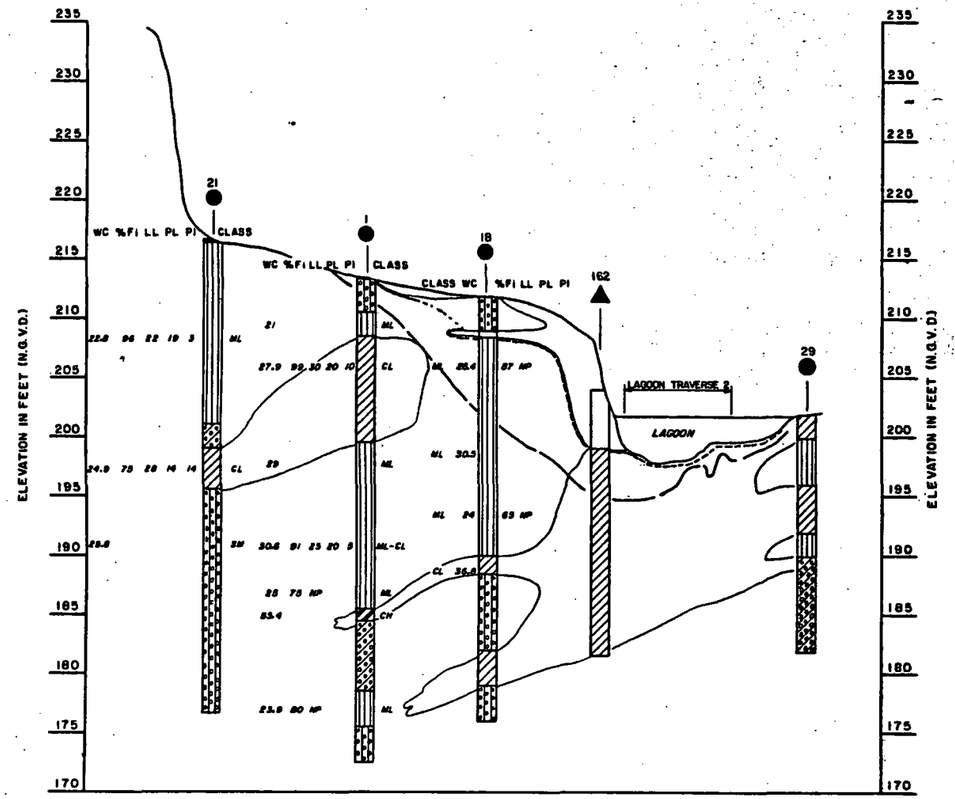
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
TULSA, OKLAHOMA

Designed by: Joseph A. Smith
Drawn by: Steven M. Carr
Checked by: E.N. Hilbert
Submitted by:
Chief:

PINE BLUFF ARSENAL
PINE BLUFF, ARKANSAS
PN 008300 FY-86
HAZARDOUS LANDFILL / CLOSURE SITES

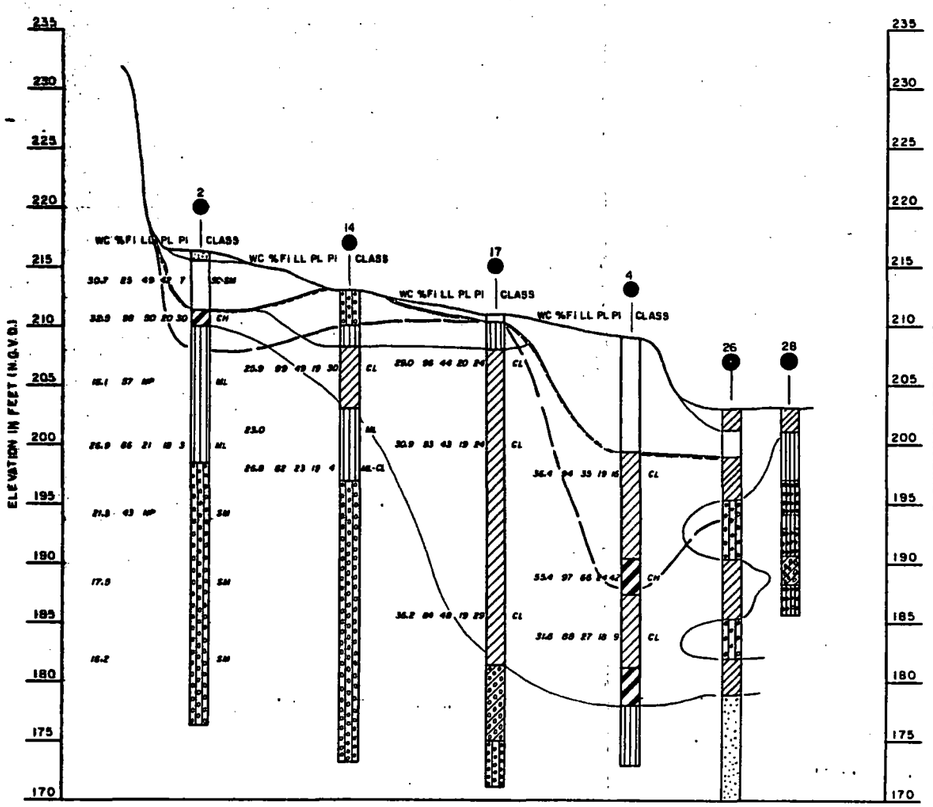
SITE 20A
GEOLOGIC SECTION B-B

Scale:
Date:
Dwg Code:
Sheet reference number:
Sheet 5 of 8



GEOLOGIC SECTION C-C

SCALE IN FEET
60 0 60 120



GEOLOGIC SECTION D-D

SCALE IN FEET
60 0 60 120

NOTE: FOR LEGEND SEE DRAWING NUMBER 4.

Revisions			
Symbol	Descripeons	Date	Approved

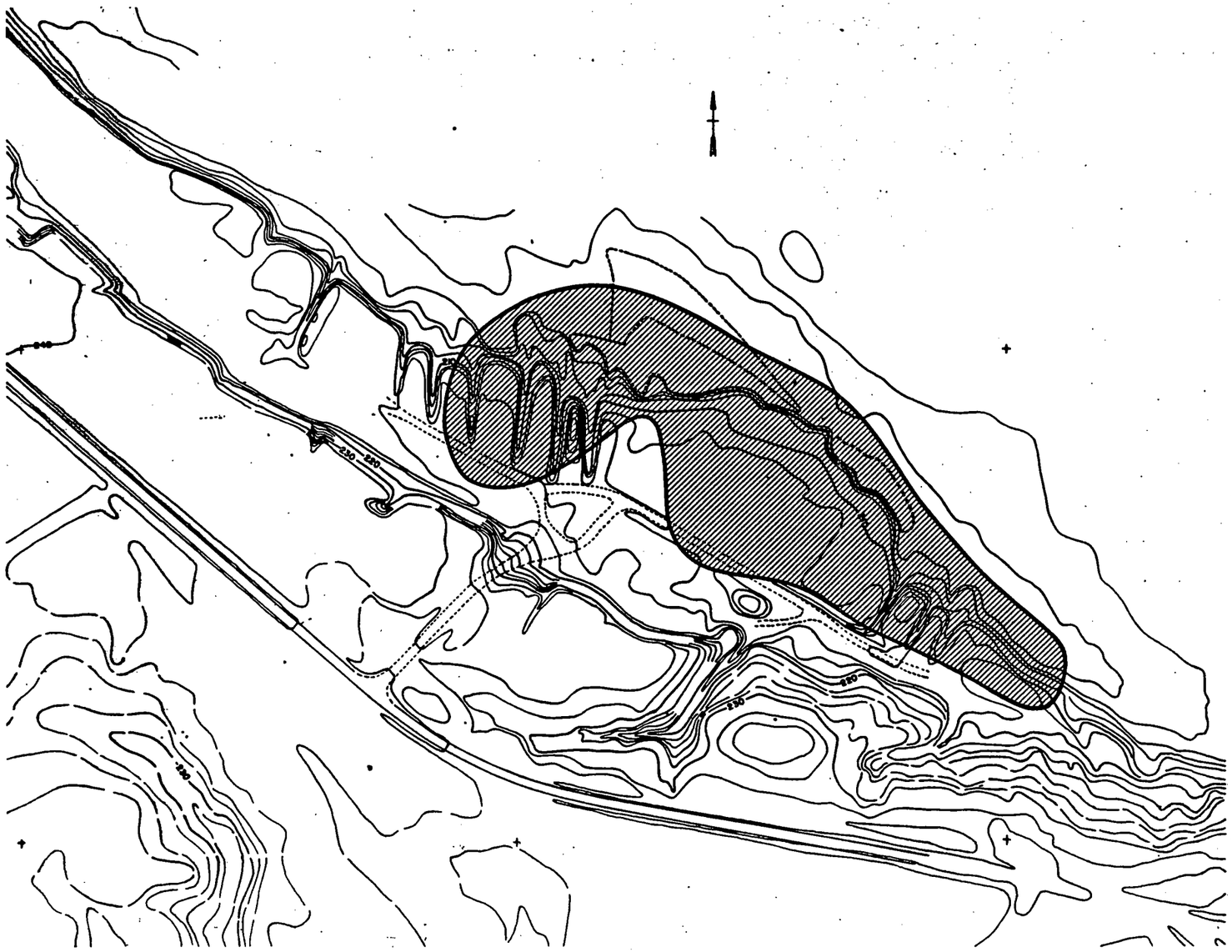
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
TULSA, OKLAHOMA

Designed by: Joseph A Hoehn
Drawn by: Steven McCann
Checked by: E.N. Gilbert
Submitted by:
Chief

PINE BLUFF ARSENAL
PINE BLUFF, ARKANSAS
PM-008300 FY-86
HAZARDOUS LANDFILL/CLOSURE SITES

SITE 20A
GEOLOGIC SECTIONS C-C AND D-D

Scale
Date
Dwg Code
Sheet reference number
Sheet 6 of 8



EXTENT OF CLAY

SCALE OF FEET
100 0 100 200

Symbol	Revisions Descriptions	Date	Approved

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
TULSA, OKLAHOMA

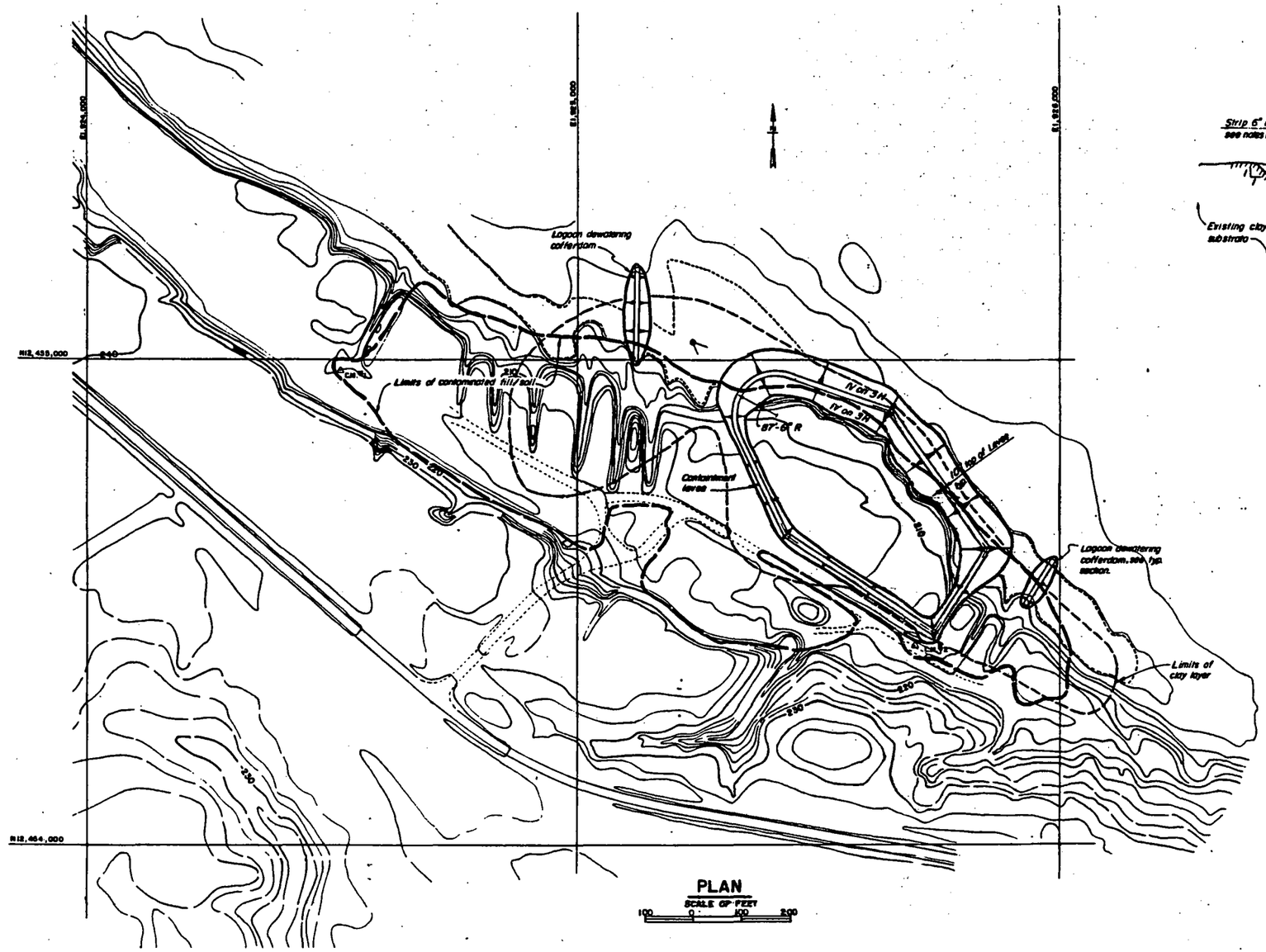
Designed by
Drawn by
Checked by E.M. Gilbert

PINE BLUFF ARSENAL
PINE BLUFF, ARKANSAS
PM 003300
FY-85
HAZARDOUS LANDFILL/CLOSURE SITES
SITE 20A
EXTENT OF CLAY

Submitted by
Chief

Scale
Date
Dwg Code
Sheet reference number

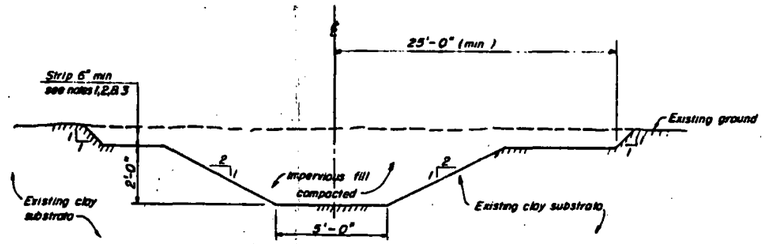
Sheet 7 of 8



PLAN

SCALE OF FEET

100 0 100 200

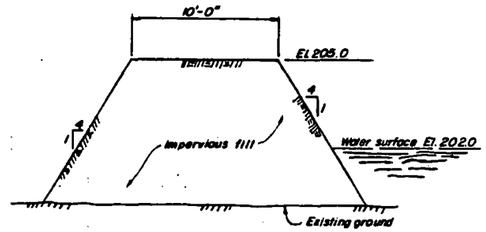


KEY TRENCH TYPICAL SECTION

NO SCALE

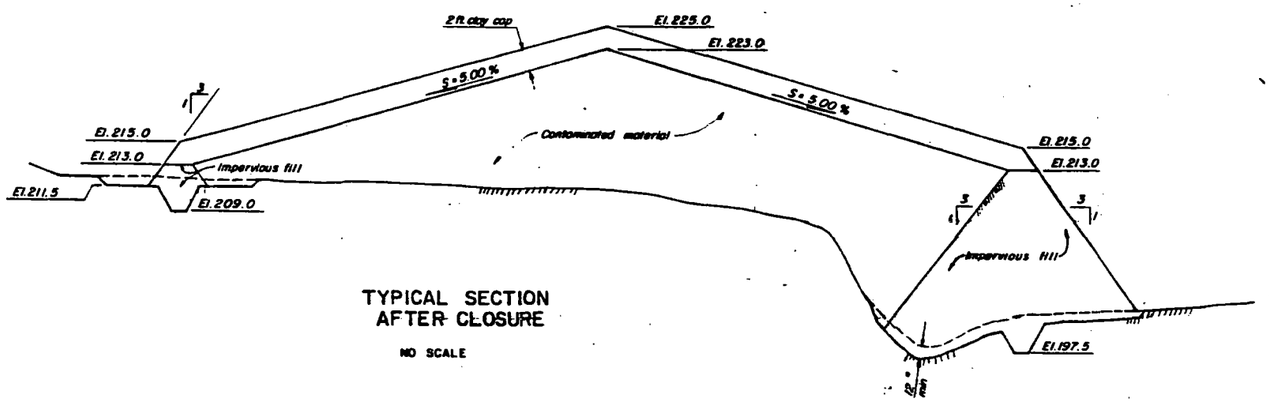
NOTES:

1. Stripping under dry land alignment of levee to be to base of contaminated fill soil, or 6" whichever is greater.
2. Stripping under lagoon alignment of levee to include all lagoon sediment plus 6" into existing clay substrate, or 12" total whichever is greater.
3. Stripped and excavated key trench material to be stockpile on site for disposal within containment levee.



TYPICAL COFFERDAM SECTION

NO SCALE



TYPICAL SECTION AFTER CLOSURE

NO SCALE

Symbol	Revisions: Descriptions	Date	Approved

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
TULSA, OKLAHOMA

Designed by: Joseph A. Oldfield
Drawn by: Steven McCann
Checked by: E. N. Dillard
Submitted by:
Chief:

- PINE BLUFF ARSENAL
- PINE BLUFF, ARKANSAS
- PN-008300 FY-86

HAZARDOUS LANDFILL/CLOSURE SITES

SITE 20A
CLOSURE PLAN

Scale:
Date:
Dwg. Code:
Sheet reference number:
Sheet 8 of 8